Joint Pub 3-59

Joint Doctrine, Tactics, Techniques, and Procedures for Meteorological and Oceanographic Operations

23 March 1999

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
23 MAR 1999	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Joint Doctrine, Tactics, Techniques, and Procedures for Meteorological and Oceanographic Operations	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Joint Chiefs of Staff Washington, DC**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**111**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

PREFACE

1. Scope

This publication sets forth the joint doctrine and tactics, techniques, and procedures for the planning and execution of meteorological, oceanographic, and space environmental operations throughout the range of military operations.

2. Purpose

This publication has been prepared under the direction of the Chairman of the Joint Chiefs of Staff. It sets forth doctrine and selected joint tactics, techniques, and procedures (JTTP) to govern the joint activities and performance of the Armed Forces of the United States in joint operations and provides the doctrinal basis for US military involvement in multinational and interagency operations. It provides military guidance for the exercise of authority by combatant commanders and other joint force commanders and prescribes doctrine and selected tactics, techniques, and procedures for joint operations and training. It provides military guidance for use by the Armed Forces in preparing their appropriate plans. It is not the intent of this publication to restrict the authority of the joint force commander (JFC) from organizing the force and executing the mission in a manner the JFC deems most appropriate to ensure unity of effort in the accomplishment of the overall mission.

3. Application

a. Doctrine and selected tactics, techniques, and procedures and guidance established in this publication apply to the commanders of combatant commands, subunified commands, joint task forces, and subordinate components of these commands. These principles and guidance also may apply when significant forces of one Service are attached to forces of another Service or when significant forces of one Service support forces of another Service.

b. The guidance in this publication is authoritative; as such, this doctrine (or JTTP) will be followed except when, in the judgment of the commander, exceptional circumstances dictate otherwise. If conflicts arise between the contents of this publication and the contents of Service publications, this publication will take precedence for the activities of joint forces unless the Chairman of the Joint Chiefs of Staff, normally in coordination with the other members of the Joint Chiefs of Staff, has provided more current and specific guidance. Commanders of forces operating as part of a multinational (alliance or coalition) military command should follow multinational doctrine and procedures ratified by the United States. For doctrine and procedures not ratified by the United States, commanders should evaluate and follow the multinational command's doctrine and procedures, where applicable.

For the Chairman of the Joint Chiefs of Staff:

V. E. CLARK
Vice Admiral, US Navy
Director, Joint Staff

Intentionally Blank

TABLE OF CONTENTS

APPENDIX

GLOSSARY

FIGURE

EXECUTIVE SUMMARY
COMMANDER'S OVERVIEW

- **Provides an Overview of Importance of Meteorological and Oceanographic (METOC) Conditions to Joint Force Operations**
- **Discusses Combatant Command METOC Organizations**
- **Covers the Principles of METOC**
- **Discusses Joint Force METOC Operations**

Overview

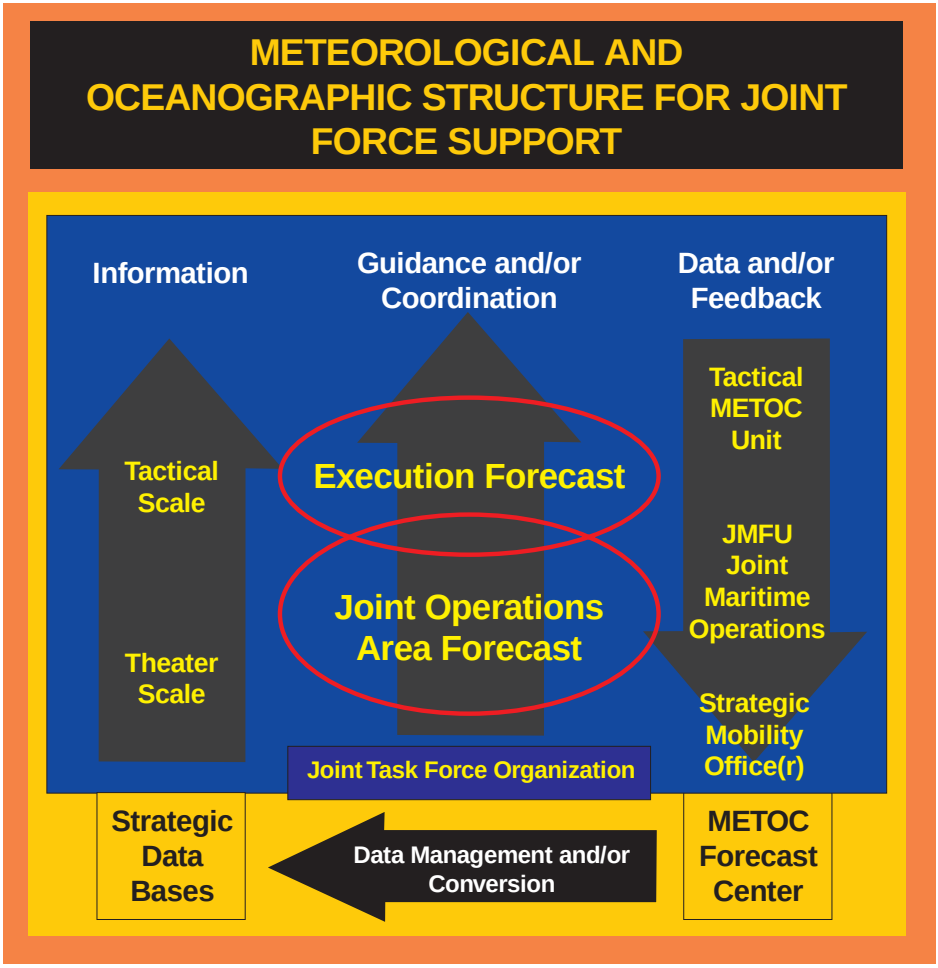
Meteorological and oceanographic (METOC) conditions will encompass the entire range of environmental phenomena extending from the bottom of the ocean into space, and will influence all components of military capability.

During military operations, adverse and/or unfavorable meteorological and oceanographic (METOC) conditions are sometimes encountered. **Accurate, timely, and reliable** METOC information can provide the commander with knowledge necessary to anticipate and exploit the best window of opportunity to plan, execute, support, and sustain specific operations. The **joint METOC forecast unit** (JMFU) concept is the **cornerstone** of the three-tiered (strategic, operational, and tactical) support structure. An invaluable aspect of the JMFU is the ability to **fuse METOC information from a variety of sources** into a coherent METOC picture and provide a **comprehensive suite of customer tailored products**. The joint METOC officer (JMO) directs the JMFU when it is in the operational area, or closely coordinates when it is at a Meteorological and Oceanographic Forecast Center, and interacts with the commander, joint task force's (CJTF's) staff to determine objectives and requirements that support effective planning and execution of joint operations.

One Theater, One Forecast

METOC forecasts can be developed for the near or far term to cover global, theater, and tactical scales.

The JMFU's **joint operations area forecast** (JOAF) provides the **official forecast** for operational planning and should be used by all operational planners in the joint operational area. It provides a discussion and rationale for the expected METOC conditions that impact joint force operations during the forecast period. Component activities communicate significant differences between their forecasts and the JOAF with the JMFU to maximize situational awareness of present METOC



conditions plus facilitate assessment of future METOC conditions and their impact on joint operations. This process is universally regarded in the METOC community as supporting a **"one theater, one forecast" concept**. The JMO is the final authority for the JOAF and will ultimately settle any significant differences over the forecast content of the JOAF raised by participating METOC agencies.

METOC Principles

The METOC principles consist of timeliness, accuracy, relevance, unity of effort, readiness, and effectiveness.

METOC forces, data bases, products, and equipment must be responsive to the requirements of the CJTF. To be responsive, **readiness** must be maintained through properly joint-trained personnel with compatible joint communication capabilities. The overall effectiveness of METOC operations requires METOC organizations at all levels to be **fully integrated in**

the planning and execution of all military actions. The use of **customer feedback** will continually improve the primary METOC functions: sensing and collecting data, analysis, forecasting, tailoring data into information, disseminating, and evaluating.

CONCLUSION

This publication sets forth the joint doctrine and tactics, techniques, and procedures for the planning and employment of METOC operations throughout the range of military operations.

Intentionally Blank

CHAPTER I
INTRODUCTION

"Know yourself, know your enemy; Your victory will never be endangered. Know the ground, know the weather; Your victory will then be total....."

Sun Tzu, Chinese General, 500 B.C.

1. Overview

This chapter summarizes the **meteorological and oceanographic (METOC) contributions** to US military capabilities as well as **roles of METOC personnel**, and provides a **brief overview** of this publication. Throughout this publication, the word "METOC" will refer to the entire range of environmental phenomena extending from the ocean floor into space. METOC phenomena include the effects on warfare of oceanography, meteorology, and the space environment. METOC conditions influence all aspects of military operations.

2. METOC's Impact on Military Capability

During military operations, **adverse and/or unfavorable METOC conditions** are sometimes encountered. Accurate, timely, and reliable METOC information can provide the commander with the knowledge necessary to anticipate and exploit the best window of opportunity to **plan, execute, support, and sustain** specific operations. **Exploiting** METOC information to optimize employment of sensors, weapons, logistics, equipment, and personnel is key to successful military operations. Likewise, military operations can

METOC conditions influence all components of military capability.

Military operations can be made difficult by failing to consider METOC conditions.

be made needlessly difficult by **failing to consider** the effects of METOC conditions. Even the most technologically advanced weapon or sensor system can be **influenced by the environment**. Making **aggressive use** of the full spectrum of METOC information is essential to every facet of military force planning, deployment, and employment, as well as system design and evaluation.

3. Role of METOC Personnel

a. METOC personnel provide tailored information on the **climatological** (historical), **current**, and **forecast conditions** of the atmosphere, ocean, land, and space environments within or through which weapon systems and their supporting infrastructure operate. METOC resources function as an integral part of the joint force. Their most important function is to provide the joint force commander (JFC) and subordinate forces with information that can **enhance mission effectiveness** through **optimum employment** of weapon systems. METOC personnel can provide information important to personnel safety and resource protection; the development of new equipment, weapon systems, combat tactics, and tactical decision aids; and intelligence gathering. The **Air Force, Navy, and Marine Corps METOC personnel** comprise the resources from which joint METOC operations are tailored to meet the unique needs of the JFC. (Note: In accordance with the National Security Act of 1947, the Air Force provides personnel and resources to meet most of the METOC information needs for Army operations except direct support of Army artillery systems.)

b. US military operations have become increasingly joint and frequently multinational. This mandates that the METOC communities maintain or have ready access to a pool of expertise and resources capable of operating in this joint and/or multinational arena.

4. METOC Joint Doctrine, Tactics, Techniques, and Procedures Overview

a. This publication provides the basic doctrine, tactics, techniques, and procedures to describe how **METOC assets should be employed in joint operations**. Although **primarily written for the JFC and subordinate METOC staffs**, it has applications down to the tactical level and should be used by all supporting METOC activities.

METOC personnel provide tailored information on the conditions of the atmosphere, ocean, land, and space environments.

b. This publication describes the **capabilities, roles, functions, planning considerations**, and **employment** and **integration concepts** of each METOC element within the joint force. It also describes how the METOC Forecast Center (MFC) is involved in the process with the joint METOC forecast unit (JMFU). Additionally, this publication describes Department of Defense (DOD) communications systems, which METOC forces employ, to the extent necessary for the senior METOC officer (SMO), the joint METOC officer (JMO), and all subordinate joint elements to meet the needs of the JFC. It describes METOC equipment and interoperability considerations that might assist the JFC.

Intentionally Blank

CHAPTER II
JOINT FORCE METOC ORGANIZATIONS

"The allies...prevailed because of superior meteorologists..."

President Dwight D. Eisenhower, 1961

1. Overview

This chapter outlines the **METOC organizational structure** within joint force operations. It describes the role of the key METOC personnel, units, and forces that typically support the commander of a combatant command (CINC) and a subordinate JFC such as a commander, joint task force (CJTF).

2. Senior METOC Officer

Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3810.01A, "Meteorological and Oceanographic Operations," specifies that the CINC is ultimately responsible for the direction of METOC assets within the area of responsibility (AOR). The **SMO is the CINC's staff officer** assigned to fulfill this responsibility. The SMO interacts with the CINC's staff, the command's Service and functional components, and the MFC to **develop and execute a METOC concept of operations**, **identify information requirements**, and **ensure unity of effort**.

3. Joint Force METOC Officer

CJCSI 3810.01A, "Meteorological and Oceanographic Operations," specifies that a JFC is ultimately responsible for the direction and coordination of METOC activities under the JFC's operational control. The **JMO acts as the CJTF's agent** to fulfill this responsibility. Although the JMO and the JMO's staff are normally on the CJTF's Operations staff (J-3), the CJTF may organize them as necessary to best support the mission. During execution, the JMO should collocate with the Joint Operations Center. The JMO plays a **critical role in preparing for the success** of the joint force mission by **supporting** either **deliberate planning for contingencies**, or **reacting to a situation using crisis action planning procedures**. The JMO interacts with the CJTF's staff (Intelligence (J-2), J-3, Logistics, Plans, and Command, Control, Communications, and Computer Systems (J-6)), the components of the joint force, the JMFU, the SMO, and the MFC to monitor the METOC operation and coordinate resource, communication, and information requirements with the SMO. The JMO is ultimately responsible for **assembling**, **organizing**, and **tasking the JMFU** or, at a minimum, ensuring that the JMFU's duties as outlined in Chapter IV, "Joint Force METOC Operations," are carried out. It is important to note that the SMO could also be the JMO.

4. Joint METOC Advisory Group

The SMO has a wide range of options and resources to use in acting as the CINC's agent for developing and executing a METOC concept of operations, identifying METOC information requirements, and ensuring unity of effort in METOC operations. For example, when planning is initiated for a joint operation, especially an operation involving multiple unified commands, the SMO has the latitude to stand up a Joint METOC Advisory Group (JMAG) — an ad hoc group of METOC experts from Service and component resources — to assist in optimizing the joint task force (JTF) METOC force.

The JMAG can assist the supported CINC's SMO by focusing the experience, expertise,

and technical capabilities of the METOC community to support the operation being planned. Initial JMAG discussions could involve sharing information concerning the operation in question, requirements for METOC products for the operation, and the appropriate data sources to produce the required products. Subsequent discussions could involve, for example, determining whether a JMFU should be established for the operation, the need for additional METOC personnel to augment METOC forces, and other topics as needed by the supported CINC's SMO.

If the supported CINC's SMO desires to establish a JMAG, the SMO should consider including representatives from theater Service METOC centers, allied and coalition METOC components, or other assets as required. A CINC's SMO will have to carefully weigh the value of expanding the JMAG to include resources outside the theater with the chain of command's desire to involve non-theater assets in an advisory role. By bringing these agencies together as needed into a single forum to assist with the operation in question, the SMO should be better prepared to assist the supported CINC in directing METOC assets within the AOR.

5. Joint METOC Forecast Unit

The JMFU concept is the **cornerstone of the 3-tiered support structure** (Figure II-1). An invaluable aspect of the JMFU is the ability to **fuse METOC information** from the MFC **with tactical information** received from the joint forces **into a coherent METOC picture** and provide a comprehensive suite of customer tailored products. Under the JMO's direction and guidance, the JMFU **develops, integrates, and maintains** the theater operational **METOC data base** for the JFC's operational area. This operational data base will typically consist of observations and forecasts from a variety of sources. The JMFU can be forward deployed with the JFC (Air Force combat weather team [CWT], US Navy [USN] mobile environmental team [MET] supporting a naval, land or air force commander, an Operations Aerology (OA) shipboard METOC division, or a US Marine Corps [USMC] meteorological mobile facility [METMF] ashore). As an alternative, the JMO can designate a dedicated support cell or element within an MFC to provide JMFU products. The JMO should consider using existing theater forecast units as the JMFU whenever possible.

Airborne operations depend on direct support from deployed weather teams.

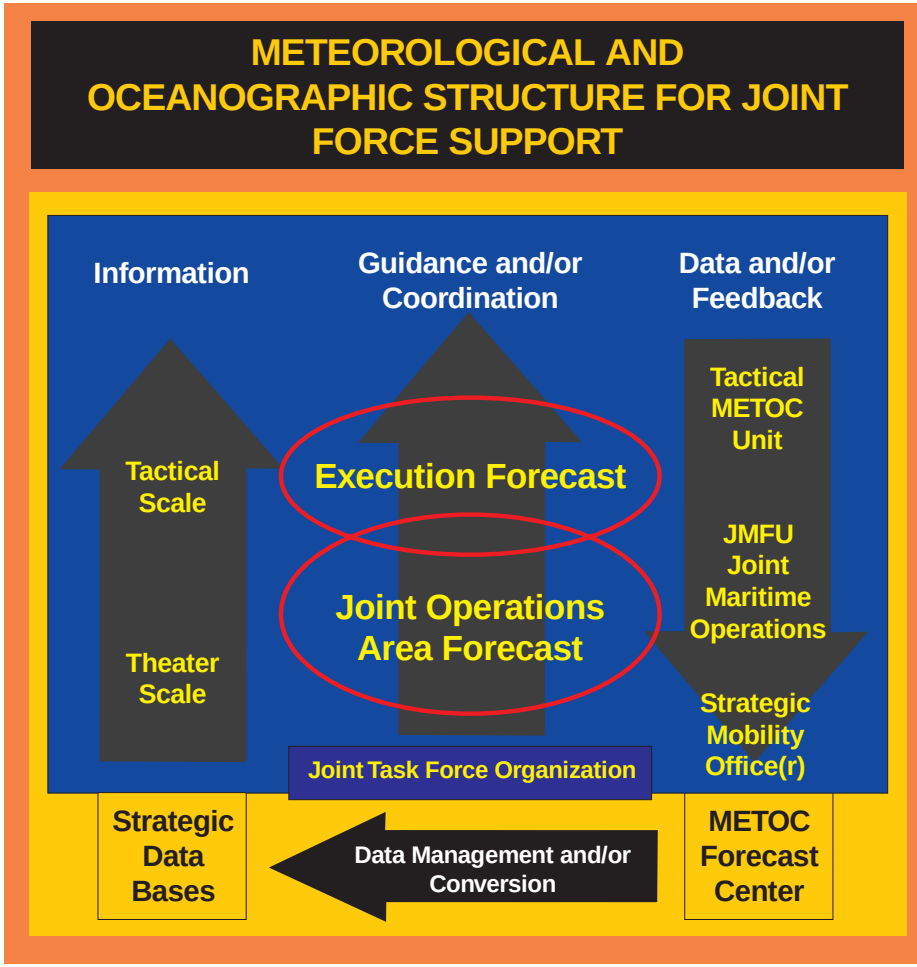


Figure II-1. Meteorological and Oceanographic Structure for Joint Force Support

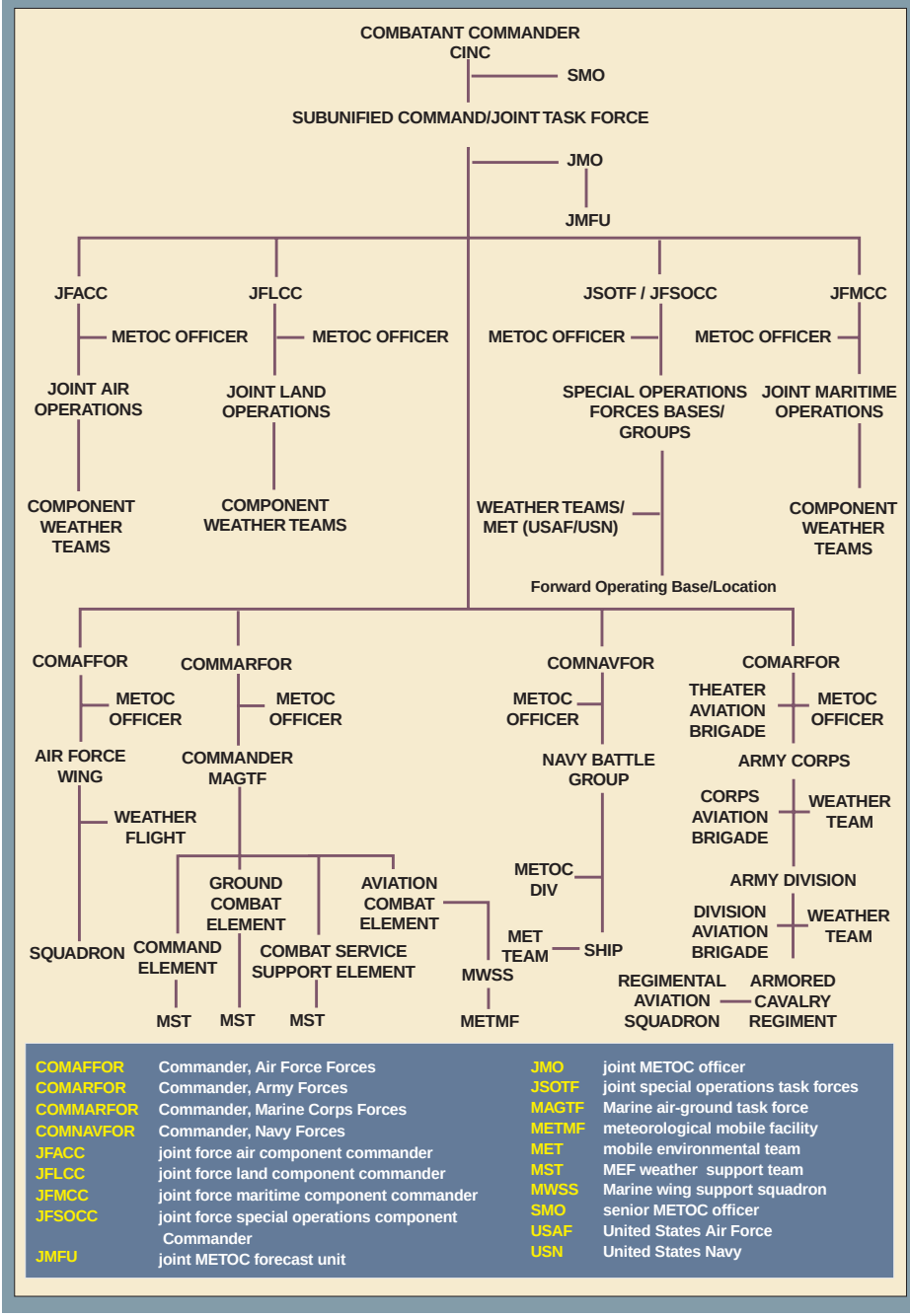
6. Joint Force Service Components METOC Organizations

Regardless of whether the CJTF organizes the forces into Service or functional components, or a mix of both (Figure II-2), each Service involved in the operation brings its **own organic METOC resources**.

a. **Air Force.** The Air Force forces (AFFOR) component receives **direct weather support** at the Commander, Air Force Forces air operations center, or other elements of the theater air control system, and at subordinate wings, groups, and squadrons requiring METOC support for conducting operations. US Air Force (USAF) METOC personnel provide direct METOC services to their component customers using organic METOC personnel which are augmented, as required, by additional Air Force personnel.

b. **Army.** Per applicable Service directives, the **Air Force provides meteorological services for the Army forces (ARFOR) component** so the Army is able to accomplish its assigned operational objectives. Army meteorological sections are responsible for providing direct upper air

TYPICAL JOINT FORCE/METEOROLOGICAL AND OCEANOGRAPHIC ORGANIZATION



COMAFFOR	Commander, Air Force Forces	JMO	joint METOC officer
COMARFOR	Commander, Army Forces	JSOTF	joint special operations task forces
COMMARFOR	Commander, Marine Corps Forces	MAGTF	Marine air-ground task force
COMNAVFOR	Commander, Navy Forces	METMF	meteorological mobile facility
JFACC	joint force air component commander	MET	mobile environmental team
JFLCC	joint force land component commander	MST	MEF weather support team
JFMCC	joint force maritime component commander	MWSS	Marine wing support squadron
JFSOCC	joint force special operations component Commander	SMO	senior METOC officer
		USAF	United States Air Force
JMFU	joint METOC forecast unit	USN	United States Navy

Figure II-2. Typical Joint Force/Meteorological and Oceanographic Organization

support to Army field artillery units, relative to their operations.

c. **Navy.** The Navy forces (NAVFOR) component receives METOC support from a multitude of different METOC agencies. Ashore METOC centers, facilities, and detachments provide regional support to forces afloat and shore activities. **Deployed METs provide METOC operations to those military assets without organic environmental capabilities. Afloat OA divisions provide organic METOC capabilities to fleet assets** (e.g., aircraft carriers, large deck amphibious, and command ships).

d. **Marine Corps.** Staff weather officers assigned to **Marine Corps forces (MARFOR), Marine expeditionary force (MEF) headquarters, Marine aircraft wing headquarters,** and personnel assigned to the **Marine wing support group (MWSG)** and **Marine wing support squadron (MWSS)** provide the Marine Corps with METOC support. The MWSG and MWSS are part of the aviation combat element of the Marine air-ground task force (MAGTF). MEF weather support teams (MSTs), are task-organized to support all elements of the MAGTF and the JMFU.

7. Joint Special Operations Task Force

Personnel assigned to the theater **special operations command** (either dedicated or as an additional duty) plan for METOC support to the joint special operations task force (JSOTF). Service special operations component METOC assets support the JSOTF when it stands up. Subordinate Army and Air Force components have organic meteorology support provided by Air Force units. Dedicated Air Force **special operations weather teams** (SOWTs) are normally under the tactical control of Army special forces groups and battalions, the Ranger Regiment,

Personnel assigned to the theater special operations command plan for METOC support.

and the Special Operations Aviation Regiment. The Air Force provides dedicated SOWTs to Air Force special operations bases and detachments. The Navy's METs augment Naval special warfare units and provide METOC operations to the JSOTF and other special operations forces (SOF) ashore as required.

8. Joint Force Functional Component Commands METOC Organizations

Joint METOC personnel are almost never organic to functional components. When available, functional component commanders must rely on METOC resources provided by the Service forces within their functional command. To satisfy all functional component commander's requirements, however, the METOC operation may require **augmentation from other Service**

F-18 operations depend on direct support from METOC personnel.

components. In either case, this requires early SMO, JMO, and Service component coordination to ensure adequate staffing. Enough METOC personnel and equipment must be available to be responsive to the needs of the functional component commander and to exploit and tailor JMFU and MFC products to meet unique mission requirements.

a. **Joint Force Air Component Commander (JFACC).** If the JFACC is dual-hatted as a Service component commander, the **JFACC will normally have a staff** to provide METOC information. This METOC staff (with augmentation from other Services, as required) should be adequate to successfully execute the JFACC's responsibilities. The JFACC requires METOC information to support development of the air tasking order and a wide range of air operations.

b. **Joint Force Land Component Commander (JFLCC).** Regardless of whether the JFLCC is ARFOR or MARFOR, METOC forces organic to the Marine Corps and/or Air Force units assigned to assist Army forces are usually available and adequate to support JFLCC operations (with augmentation from other Services as required). The JFLCC requires METOC information focused on the **operational area**, **its approaches**, and **threat force occupied areas**.

c. **Joint Force Maritime Component Commander (JFMCC).** Regardless whether the JFMCC is NAVFOR or MARFOR, METOC forces organic to those two Service

METOC personnel are almost never organic to functional components.

components should normally be available for use by the JFMCC (with augmentation from other Services as required). The JFMCC requires METOC information focused on the **operational area**, **its approaches**, and **threat force occupied areas**.

d. **Joint Force Special Operations Component Commander (JFSOCC).** The Service special operations components' METOC forces **provide augmentation** which support the JFSOCC METOC operations.

Intentionally Blank

CHAPTER III
JOINT FORCE METOC PRINCIPLES

"The rapid transmission by wireless of meteorological information is of the utmost importance...."

General Erich F. W. Lundenhoff
German General Staff 1917

1. Overview

This chapter describes METOC principles that are the **cornerstone of joint force METOC operations**. By applying these principles, METOC staffs are better prepared to enhance and sustain joint force operations.

2. METOC Principles

a. **Timeliness.** METOC operations are only effective when the CINC and subordinate JFC receive accurate METOC information **in time to consider its impact** within their decision making cycle. **Reliable communication links** between all joint METOC forces are vital in order to support and sustain the timely dissemination of METOC information and are key to the overall capability of METOC forces.

b. **Accuracy.** Joint forces depend on accurate METOC information to **plan and direct their operations**. Inaccurate information can cost lives, undermine the successful execution of a mission, waste resources, and impair readiness. This is true across the range of military operations. All of the following affect the accuracy of METOC information: the capability to **collect data** within the area of interest with **sufficient spatial and temporal coverage** to model and forecast the METOC conditions; the **perishable nature of METOC data**; and **human error**. The impact these factors have on forecast accuracy should be explained to the JFC to enable the JFC to weigh these factors when making weather sensitive operational decisions.

c. **Relevance.** Attaining this principle requires the joint force user to communicate its specific **requirements for content, form, medium, presentation, timeliness**, and **frequency of delivery**, and asks METOC personnel to satisfy these requirements. It will influence the joint force's current, planned, and alternative courses of action (COAs) at each level of responsibility. Each operation requires tailored METOC information so that the user can quickly identify and apply relevant information without additional analysis or manipulation.

d. **Unity of Effort.** METOC information that influences a JFC's decision usually cannot be derived from a single source. Instead, METOC data from the MFC, component, and tactical sources should be assembled into a data base that contains a **complete and integrated summary of METOC conditions** of interest to the JFC and all component commanders. This will simplify access and ensure consistency of data used by multiple forecast activities. Within a **joint force, there must be unity** of effort to ensure the METOC data base is **complete**, **up-to-date**, **consistent**, and **accurate**. To accomplish this task, METOC organizations at all levels should have clearly defined functions, outlined in an operation plan (OPLAN) or operation order (OPORD), Annex H, or letter of instruction (LOI), which eliminate unnecessary duplication, maximize

sharing of information, and mutually support the overall METOC concept. Collaboration and coordination between functional and Service component METOC forces is critical when METOC conditions will impact one component's ability to support another component (i.e., tanker support or coordinated air strikes).

e. **Readiness.** METOC forces, data bases, products, and equipment must be responsive to the requirements of the JFC. To be responsive, readiness will be maintained through Service component participation in joint exercises and operations. Communications equipment will be interoperable with joint and Service component capabilities. Where required, METOC resources must be maintained in a degree of readiness that ensures **immediate employment capability**. METOC plans developed to support joint operations should be exercised and evaluated in realistic training scenarios to ensure that those plans are feasible and can support the overall mission at all levels. Conducting joint exercises trains assigned forces, maintains readiness, enhances interoperability, and confirms the feasibility of communications and OPLANs. The Services should plan and coordinate standardized and interoperable equipment and training techniques to realize a **seamless transition to joint wartime and/or contingency METOC operations**. Service components should identify their training requirements for inclusion in CINC and Chairman of the Joint Chiefs of Staff (CJCS) sponsored exercises through the CINC's SMO. Joint training requirements are developed from the CINC's Joint Mission Essential Task List as governed by Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3500.03, "Joint Training Manual for the Armed Forces of the United States."

METOC organizations at all levels are required to be fully integrated in the planning and execution of all military actions.

f. **Effectiveness.** The overall effectiveness of METOC operations should be based on the **successful and effective use of METOC information in support of specific joint force operations**. Each METOC organization should direct its actions toward this goal and constantly assess its performance. This requires METOC organizations at all levels to be **fully integrated in the planning and execution** of all military actions and to use **customer feedback** to continually improve their overall effectiveness.

CHAPTER IV
JOINT FORCE METOC OPERATIONS

"In military operations, weather is the first step in planning and the final determining factor in execution of any mission..."

General Carl Spaatz
Air Force Chief of Staff, 1948

1. Overview

This chapter describes the **primary operations** that the METOC community performs in order to enhance joint military operations, both in combat and noncombat. Additionally, joint force METOC functions, responsibilities, SMO and JMO duties, JMFU operations, and Service and/or functional component operations are described. The **integration of METOC capabilities** during all phases of OPLAN development and the ability to provide accurate and timely METOC information as an operation unfolds is critical to the success of joint force operations.

2. Joint Force METOC Functions

a. **Sensing and Collection.** METOC operations depend on the timely collection of **high quality METOC data**. The foundation for effective METOC operations is set by **observations from aerospace, land, and at sea** by sensors or platforms such as upper air sounding devices; meteorological satellites; weather radar; lightning detection systems; atmospheric profilers; solar telescopes; ionospheric sounders; space-based space environment sensors; buoys; unmanned aerial vehicles (UAVs); remote surface sensors; tide gauges; current meters; and topographic and bathymetric data collection devices. These observations, gathered from friendly and unfriendly areas of interest, are the essential components of **theater and/or regional and worldwide data bases** from which METOC services and products are derived. Due to the rapidly changing nature of the METOC environment, these observations are extremely perishable and must be continuously updated and available to METOC organizations. The JMO must develop and implement a **sensing and collection strategy** for METOC data management that orchestrates the timing, distribution of collection sites, and efforts of all components within the joint force, as well as reliable sources of foreign data. A complete strategy will **ensure unity of effort** while **optimizing data collection**, **dissemination**, and **integration** into forecast products. Spreading observational resources across an area of interest with regard to climatic zones to obtain optimum coverage will significantly improve the quality of METOC services. Figure IV-1 gives an example of the management of METOC data and applicable operations taking place within an area of interest.

b. **Analysis.** After collection of available data, the MFC, JMFU, and component METOC activities develop a **coherent picture of the current state of the METOC environment** for their level of interest (national strategic, theater strategic, operational, and tactical). **Analysis is the critical function which enables production of accurate forecasts of the METOC environment.** Figure IV-2 provides an example of analysis responsibilities.

c. **Forecasting.** Through timely analysis, evaluation, interpretation, and distribution of METOC data, the JMFU and other forecast elements develop specific METOC products to enhance military operations and to meet the CJTF's requirements. **METOC forecasts**

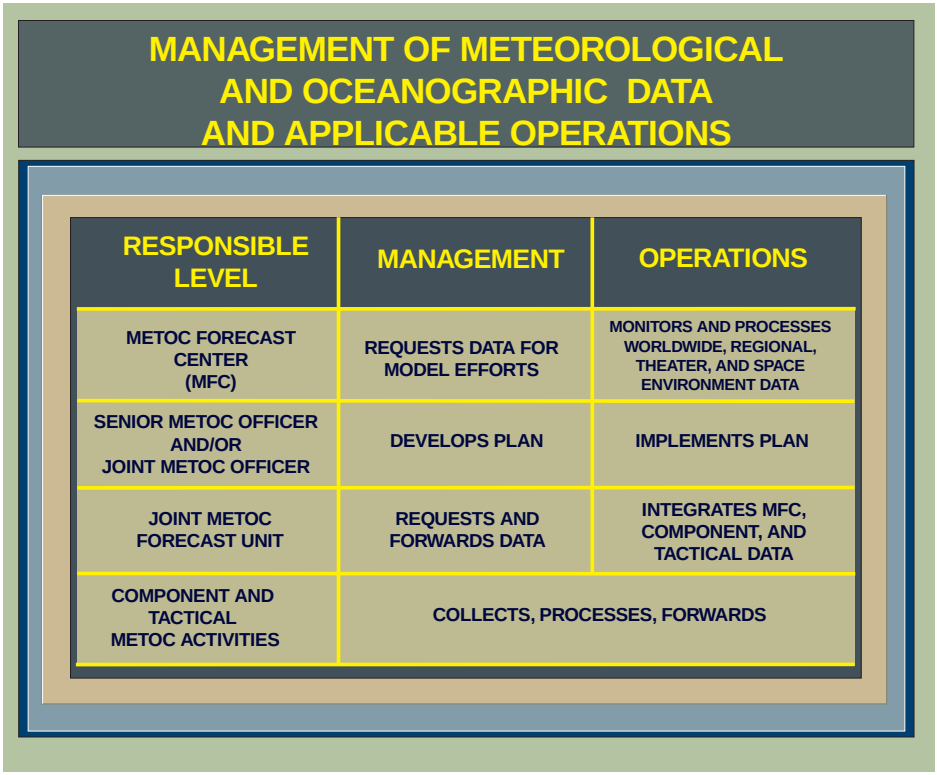


Figure IV-1. Management of Meteorological and Oceanographic Data and Applicable Operations

can be developed for the near or far term to cover global, theater, and tactical scales. These forecasts vary from generalized planning forecasts issued several days in advance of an operation to forecasts issued to support the execution of a specific mission or operation immediately prior to their launch or start. Figure IV-3 provides an example of the forecast information that is provided from different METOC levels. Within the JMFU, the JMO ultimately determines which METOC activity provides what forecast products. The **joint operations area forecast (JOAF)** provides the **official forecast** for operational planning and should be used by all operational planners in the joint operational area. It provides a discussion and rationale for the expected METOC conditions that impact joint force operations during the forecast period. It is expected that the component tactical level forecast may take a different form because of a difference in mission focus. Component activities communicate significant differences between their forecasts and the JOAF with the JMFU to maintain a **"one theater, one forecast" concept**. The **JMO is the final authority for the JOAF** and will ultimately settle any significant differences over the forecast content of the JOAF raised by participating METOC agencies. METOC personnel developing control and/or execution forecasts will use the planning forecasts as a starting point and fuse *in situ* data (e.g., target weather and intelligence [TARWI], forward area limited observation program [FALOP], pilot reports [PIREPs]) and local observations to produce tailored mission specific forecasts.

d. **Tailored Application.** A key role of the METOC community is to **enhance the decision making process** of the JFC and

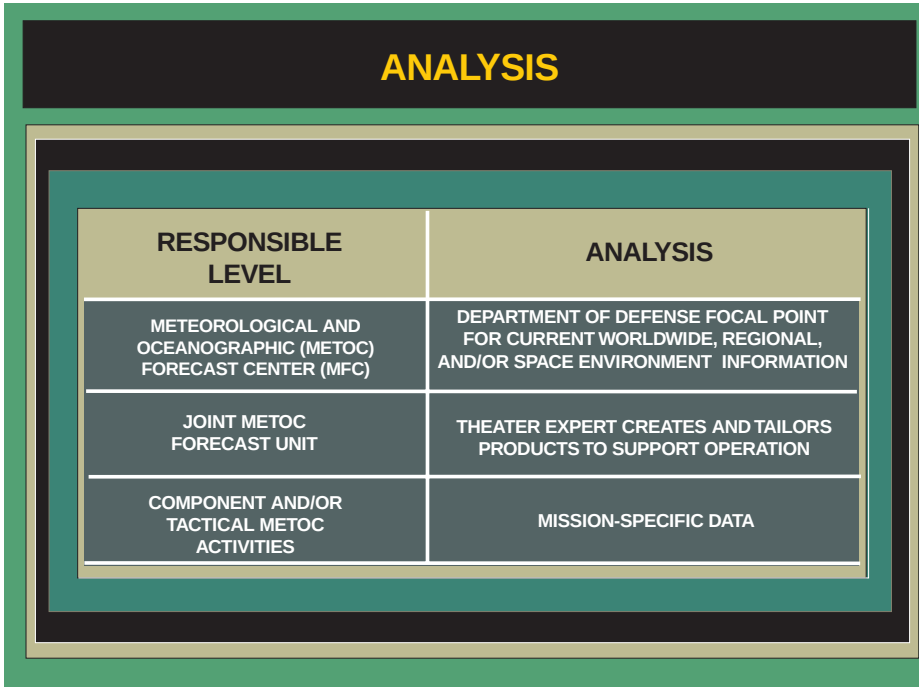


Figure IV-2. Analysis

subordinate joint forces through **tailored application of forecast products**. By receiving METOC information and its impact to operations, decision makers can **evaluate operational limitations** of both friendly and enemy weapon systems as well as **associated tactics, techniques, and procedures**. For example, integration of METOC information into the planning process allows the JFC and subordinate joint forces to make informed decisions with regard to the design and operation of a plan and the use of various weapon systems. Early integration of information from METOC studies developed from climatological data bases can aid the long-range planning of military operations as well. In another example, METOC information is included as part of the intelligence estimate of the enemy's probable COA and capabilities, based on the enemy's ability to perform in given METOC conditions. Figure IV-4 provides an example of tailored applications and/or operations based on level of responsibility.

e. **Dissemination.** Due to the **perishable nature of METOC information**, current and forecast information must have priority communications to reach the JFC and subordinate forces in time to be of operational and planning value. Therefore, observing and forecasting functions must **process and disseminate METOC information** to joint force users by the **fastest and most reliable means available**. Passing METOC information from the tactical and operational levels to the MFC, as outlined in Appendix M, "METOC Forecast Center," is vital for inclusion in METOC numerical model runs. This also allows the centers to act as backup for the JMFU, as required. **Communications is the key supporting element** for the METOC community to successfully perform its mission. Appendix J, "Communications," is dedicated to discussing communication issues. METOC personnel and users of METOC information must determine, within the JMO's theater information strategy, what information merits distribution, to whom,

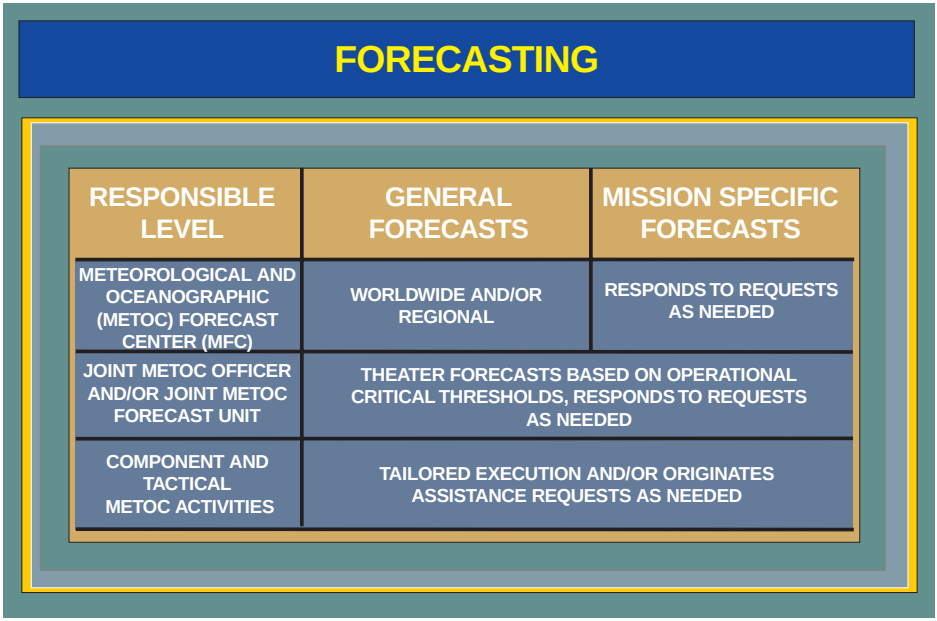


Figure IV-3. Forecasting

when, and the format and media required. This will ensure that users receive only the information needed for the task at hand rather than being inundated with unneeded products. Users of METOC information must also be able to **quickly define and request unique products** required for specific operations or weapon systems. Figure IV-5 shows the dissemination of the types of information required by the various METOC levels within a joint force.

f. **Evaluation. Operational awareness, staff networking, METOC debriefs, and the use of the Joint Uniform Lessons Learned System (JULLS)** will significantly enhance the capability to evaluate METOC effectiveness. Evaluations based upon customer requirements and/or equipment limitations **identify shortfalls** in the value of various types of products, the responsiveness of the METOC products to the user, and techniques used to provide the information. Implementing **timely corrective actions** enhances the overall quality of METOC operations. Figure IV-6 describes the METOC information within a joint force operation that should be evaluated.

3. Responsibilities

CJCS, Service, CINC, subordinate JFC, SMO, and JMO responsibilities for METOC support to joint operations are provided in CJCSI 3810.01A, "Meteorological and Oceanographic Operations." SMO and JMO duties and responsibilities are further detailed in this publication.

4. SMO and JMO Duties

The duties of the SMO and JMO are similar and interrelated during the planning and execution of joint operations. The primary difference is that an **SMO supports the CINC** in the development and maintenance of established OPLANs and operation plans in concept format (CONPLANs). Conversely, the **JMO supports a joint task force commander** in the execution of a specific mission and/or task by either modifying an existing plan or developing a new one. In all

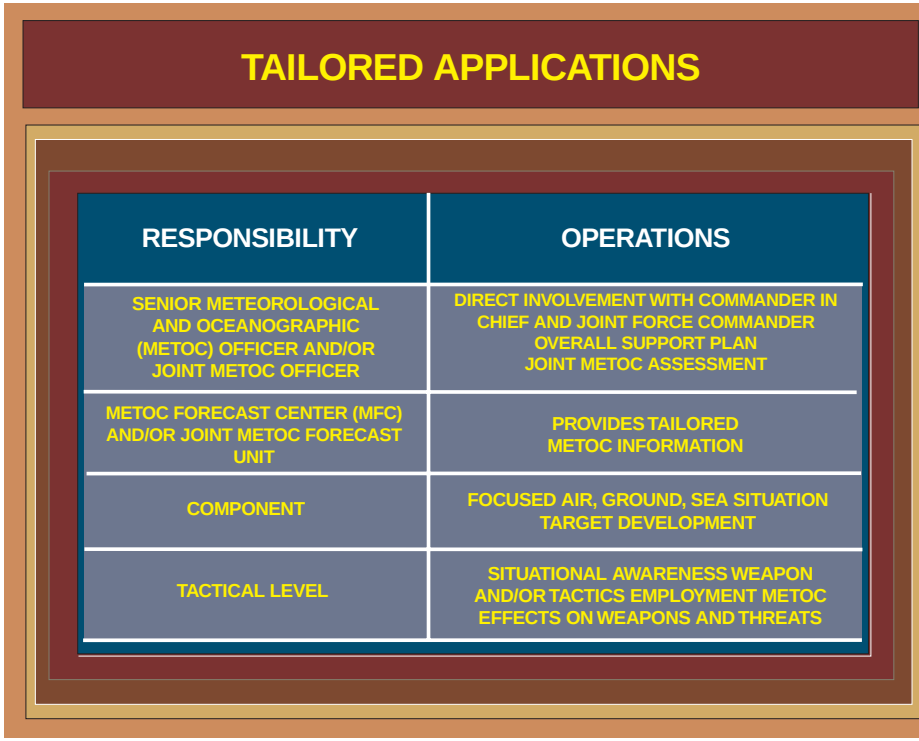


Figure IV-4. Tailored Applications

stages of time-phased force and deployment data (TPFDD) development, the SMO and/or JMO need to work with planners to ensure the appropriate mix of Service METOC personnel and equipment are identified for the joint operation. Potentially, the SMO could step in for the JMO for a particular operation and fulfill all planning and execution responsibilities. SMO and JMO duties and relationships are discussed below.

A future example of these interrelated duties will involve the Global Command and Control System (GCCS). As METOC product capability evolves on GCCS, the SMO and/or JMO at the echelon where responsibility resides for building and maintaining the common operating picture (COP) will need to determine what METOC data, products, and sources will be a part of the COP. Coordination with the JMFU will be essential to optimize this capability for joint operations.

a. **SMO Duties.** During the planning and execution of joint operations, the SMO's duties are as follows.

- Serve as the **focal point for joint force METOC support** as outlined in Appendix A, "SMO and JMO Involvement in Planning." The SMO must ensure that METOC capabilities and requirements are included in the CINC's campaign plan, OPLAN, CONPLAN, OPORD, or in the LOI, as appropriate. The SMO works with the Service component METOC officers and the CINC's staff in the development of the following annexes for each OPORD, OPLAN and CONPLAN: B (Intelligence), C (Operations), H (METOC Operations), K (Command, Control, and Communications Systems), and N (Space). Appendix B to this publication, "METOC Information in

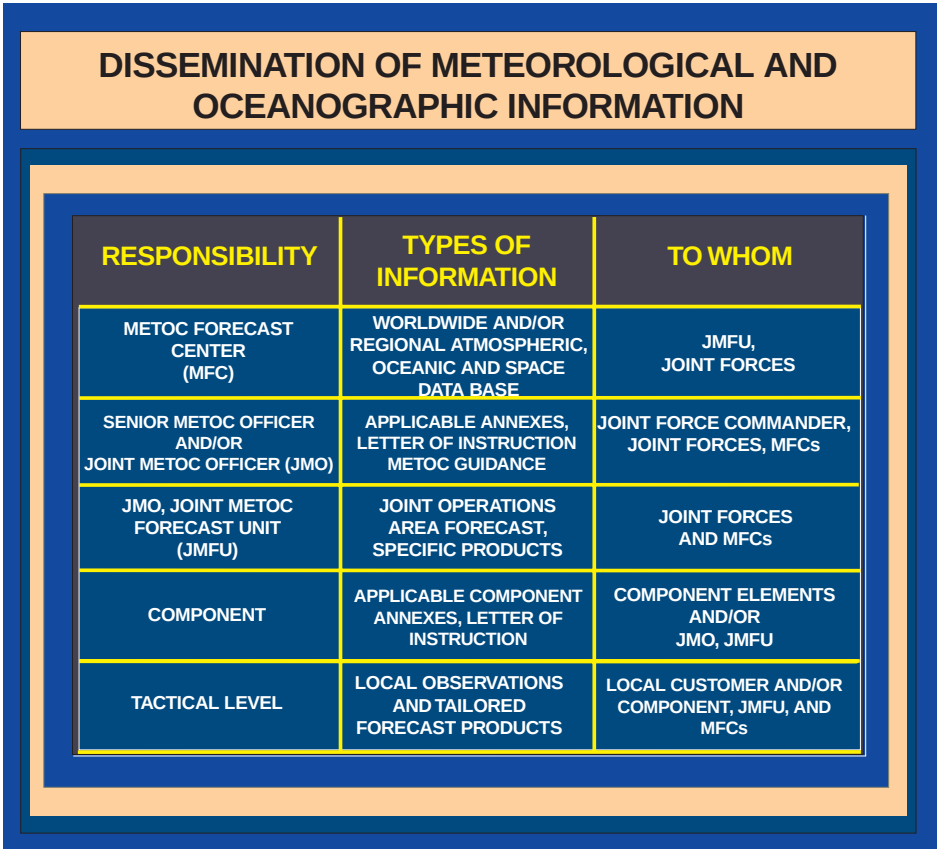


Figure IV-5. Dissemination of Meteorological and Oceanographic Information

Operation Plans," provides details on the METOC content of these annexes. Appendix C to this publication, "METOC Letters of Instruction," shows an example of an LOI that describes information important to the METOC concept. The LOI is an effective vehicle to distribute the METOC concept of operations (CONOPS) to the METOC personnel participating during contingency operations when an OPORD is not available or there are changes to an existing OPORD. CJCSM 3122.03, "Joint Operation Planning and Execution System Vol II: (Planning Formats and Guidance)," provides guidance for developing an Annex H.

- Coordinate with the **US diplomatic missions**, **Joint Staff**, and other **US agencies** as required to ensure that all available METOC information and systems, as well as indigenous assets and data, are **properly considered** and **made available**, if needed, for use by the joint force. Coordination should include a review by the servicing legal office of applicable treaties with other countries and of memoranda of understanding with non-DOD agencies that may be implicated by the provision of METOC information or services. In developing the METOC CONOPS, use of in-country assets should only complement US military METOC capabilities. US

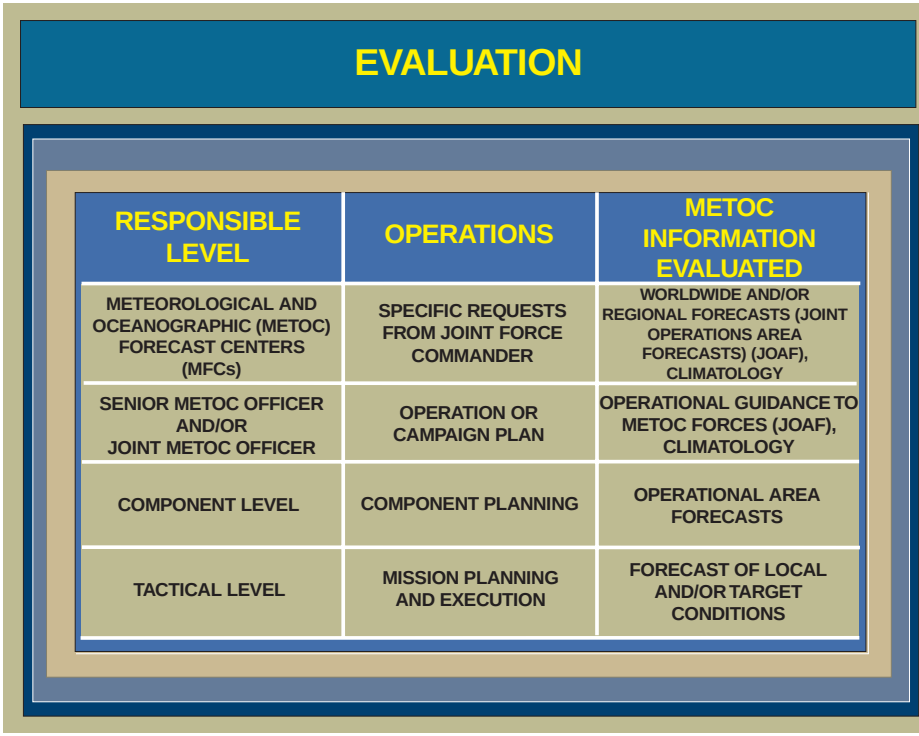


Figure IV-6. Evaluation

military METOC assets should maintain the capability to function in a stand-alone environment without indigenous assistance.

- Coordinate with the **Service component METOC officers** and the **CINC's staff** in formulating a **concept of METOC operations which supports the CINC's concept of operations**. Coordination should include the Air Mobility Command (AMC) functional manager, through the US Transportation Command (USTRANSCOM), for strategic airlift and tanker mission METOC support. Once a joint force is formed and a JMO designated, the SMO must work closely with the JMO and Service components to **obtain and synthesize METOC requirements and capabilities** prior to the execution of operations. The joint force concept of METOC operations should implement the principle of **unity of effort** by integrating the capabilities of the MFC with those of the joint force. The SMO, JMO, Service and functional components, and all elements of the JFC's staff will **plan, evaluate, and coordinate** the METOC requirements for the joint operation. These requirements include organization, location, manpower, communications, equipment, logistics, data, and products. The METOC CONOPS should include the following.

•• A summary of the operations concept based on the theater strategy.

•• The logistics concept, which outlines the support required by the joint METOC force.

•• The deployment concept (sequencing of operational capabilities via the TPFDD).

•• The organizational concept (external and internal command relationships).

•• The communications concept, developed by the J-6, to include the architecture for real time transmission of METOC data between the MFC(s) and the joint force operational area. The Services provide interoperable communications systems to ensure METOC elements within the joint force can effectively access and transfer METOC data.

•• The employment concept (day-to-day operations of forces). In developing this concept, the SMO must know customer requirements and tailor METOC operations accordingly. Some examples of questions the SMO must answer are: (1) What forces (JFC staff, component headquarters) require support and what type of METOC support is needed? (2) What are the capabilities of the MFCs? What type of support is needed for the CINC's AOR? How is support provided to the CINC's subordinate commands? Are there any shortfalls? (3) What communication system(s) are present in the CINC's AOR that will transmit and receive METOC information from the MFC to the METOC staffs and organizations under the CINC's chain of command? What systems will allow information flow throughout the subordinate JFC's chain of command? (4) Where and how will METOC data be collected, processed, and disseminated (sensing strategy and data management)?

- **Obtain METOC requirements** from all joint force components and **recommend tasking**, through the CINC, of Service components' METOC capabilities. **Coordinate with J-3**, and document in applicable OPLANs and/or CONPLANs as needed, critical environmental thresholds for restricted and/or unrestricted operations decisions. Coordinate with the JMO for MFC support or other additional capabilities required to fulfill operational needs that are not within the capability of the joint force. **Coordinate with the JMO** on METOC personnel and equipment requirements and ensure that the CINC's staff validates METOC TPFDD requirements. Work with **CINC's component commands** to coordinate METOC personnel and equipment availability for the operations.

- Ensure the **widest dissemination of METOC operations information** through the use of network homepage technologies. **Consult with J-6** for assistance in establishing the METOC Homepage on both the CINC's SECRET Internet Protocol Router Network (SIPRNET) and the Unclassified but Sensitive Internet Protocol Router Network (NIPRNET) and obtaining required command, control, communications, computers, and intelligence (C4I) connectivity. The SMO will determine specific homepage design, but recommended elements include:

  •• METOC points of contact and HOT LINKS to their respective homepage and e-mail addresses (SMO; JMO; Service components; functional components [as appropriate, e.g., special operations or JFACC]; JMFU; and MFC as a minimum);

  •• Annex H, LOI, or CONOPS, whichever is appropriate;

  •• HOT LINK to JOAF; and

  •• Specially-tailored products.

- Keep CINC appraised of METOC operations and conditions in the joint force operating area.

b. **JMO Duties**

- **Coordinate with the SMO and CJTF staff on updates** to the various annexes supporting the OPORD. Specific attention should be given to Annexes B, C, H, K, and N of the OPORD, and duties outlined in Appendix A to this publication, "SMO and JMO Involvement in Planning." Ensure that all METOC personnel and equipment are included in the TPFDD. Coordinate with the SMO to ensure that the CINC's staff validated METOC TPFDD requirements.

- **Coordinate with the SMO** to ensure that all available **METOC information and resources**, as well as indigenous assets, are **properly considered and made available** for use by joint forces. The JMO, in conjunction with the SMO, establishes and implements an **all-source theater observing strategy** that fulfills the requirements of the joint force and MFC. Attention to efficiently using all available observational assets will maximize operating area coverage and preclude duplicative efforts. As an example: multiple simultaneous weather sites recording upper-air soundings within a few mile radius should coordinate launch times to conserve resources and maximize effectiveness. Adjacent sounding sites' effectiveness can be optimized by tasking certain stations to take non-standard observations (i.e., 03, 06Z, etc.). This plan could better depict the changing atmospheric conditions. Important sources of METOC data from Service component non-METOC activities are outlined in Appendix D, "METOC Data Sources From Non-METOC Operations."

- Consistent with the scope and mission of the joint force, recommend to the CJTF the **establishment, manning, and location of the JMFU** (duties could be embedded into an existing MFC). The JMFU is an important element in the METOC organization because it is the **center for integration of all METOC data** in the joint operations area. The need to balance sufficient METOC data flow with sufficient operational input will drive the decision of where to locate the JMFU. Communications connectivity tends to drive this decision; however, the JMO must also consider available airlift, manning, equipment, and other possible restricting factors. The JMO recommends to the CJTF the **manpower requirements**, **force composition,** and **location** of the JMFU. The JMO will provide overall direction to the JMFU and the MFC production facilities supporting the operating area.

- Establish and publish **METOC product requirements** and coordinate **METOC support services** for the joint force.

- Ensure coordination for **strategic airlift and tanker mission METOC support** with either the air mobility elements, if deployed, or the AMC functional manager through USTRANSCOM.

- **Assemble the joint force METOC staff and equipment** within the operating area, consisting of the personnel and resources assigned by the CINC and consistent with the scope of the joint force mission.

- Assist the CJTF, JTF staff, centers, and the components to **understand the state of the METOC environment** in which both friendly and threat weapon systems and/or their supporting infrastructure will operate. The JMO must **validate and refine their requirements** for METOC

information to assist them in planning, conducting, and evaluating operations to achieve the CJTF objectives. Since potential missions are wide-ranging, the JMO must **be aware of METOC capabilities, assets, and resources available**. Coordinate with the SMO on **METOC manning, communications, information, and service requirements** beyond the capabilities of assigned METOC assets, and aggressively work with the joint force staff to obtain additional resources as deficiencies are identified.

- Actively **monitor and evaluate the planning and execution of the operation**, and work METOC issues that arise. During training scenarios, the key is to exercise the same process and procedures as would be employed through the range of military operations. **Feedback on the overall performance** of the METOC operation effort is critical. The JMO should aggressively work through the CJTF's staff and the JULLS for feedback on METOC support for exercises as well as operations. Figure IV-7 provides an example of procedures to determine overall METOC effectiveness to the joint force.

- Ensure that all deploying METOC forces have adequate tactical location identifiers (KQ-identifiers). Request additional identifiers using Service procedures, if required. Ensure that enough current passwords are requested for access to Joint Worldwide Intelligence Communications System (JWICS), Air Force weather information network (AFWIN) or secure Air Force weather information network (SAFWIN), or Naval Oceanographic Data Distribution System (NODDS) and/or Joint METOC Viewer (JMV). Request passwords via Service procedures, if required.

5. JMFU Operations

The **JMFU concept** is the cornerstone of the METOC three-tiered operations structure. Using Annex H, Annex K, and the LOI as the blueprint, the JMFU, under the JMO's direction, provides **overarching support to the CJTF**. The challenge for the JMFU: **take existing METOC center forecasts** and **meld with operational and tactical information**, **produce the JOAF**, and **disseminate the JOAF** to all joint forces. At the onset of a joint force operation, the CINC's SMO coordinates with MFC production sites and facilities to provide products and services for the area of interest. The SMO determines the requirement for a JMFU. If the SMO determines that existing METOC facilities are unsuitable, the JMO works in conjunction with the SMO and the CJTF staff to establish or designate a JMFU for the operation. The JMFU should be capable of producing the products necessary for the CJTF; however, it may be constrained by restrictions on movement of manpower and equipment into the joint force operating area. In the case of limited capability, production responsibilities may rest with an existing MFC production facility. The JMFU may be required to provide support directly to tactical forces in the event that organic METOC support is unavailable. During JMFU operations, other MFC elements would still provide products to out-of-operating area METOC units supporting joint force operations (e.g., airlift, long-range bombers, tankers, sealift, fleet operations). **The functionality of the JMFU may differ based on its geographic focus and/or missions.** The JMFU receives direction and information on planned operations from the JMO. The JMO is the lead action agent in the joint operations area, ensuring effective METOC operations. The JMFU is **one of the tools the JMO uses to implement** the principles of joint METOC operations. The focus is on the integration of METOC information from joint force

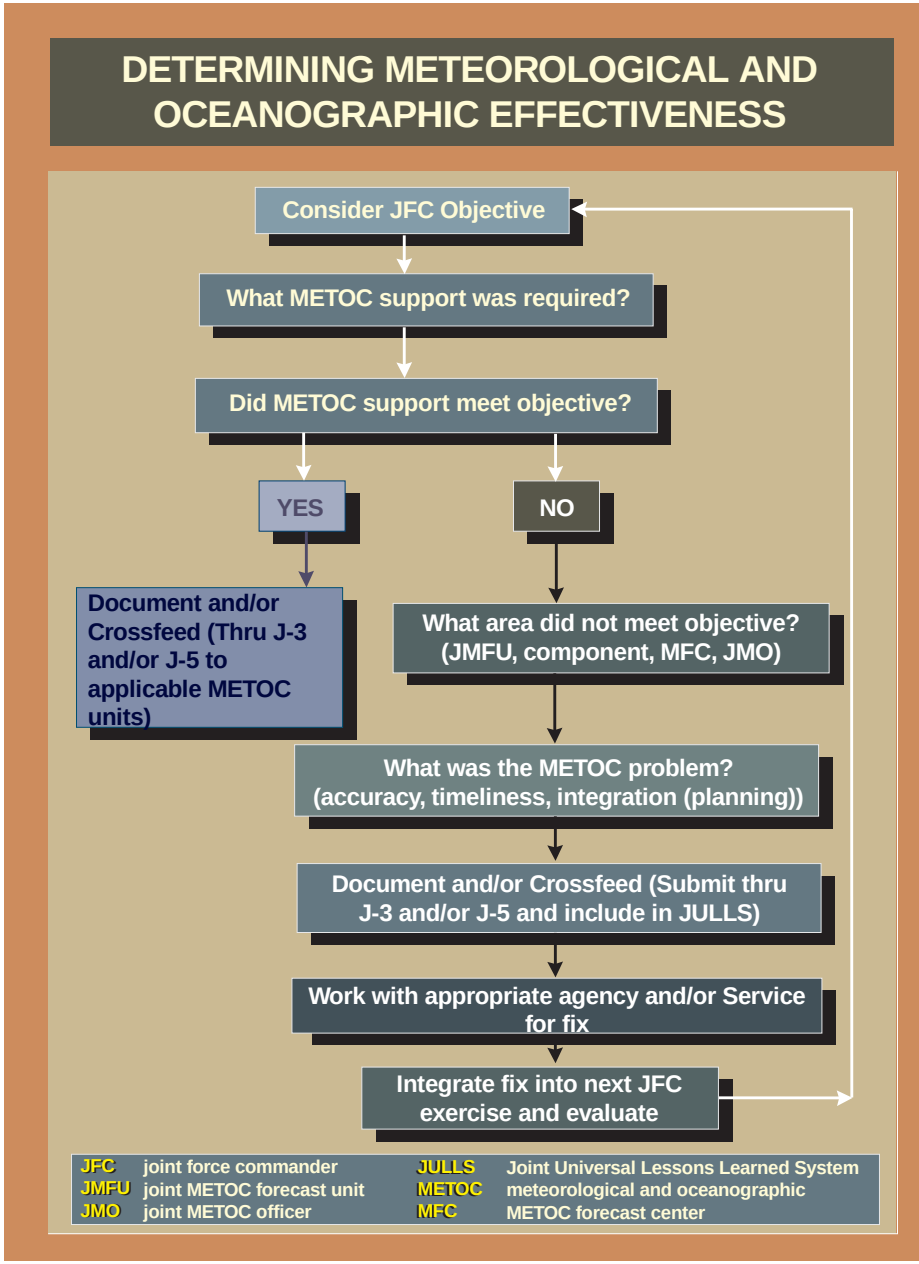


Figure IV-7. Determining Meteorological and Oceanographic Effectiveness

components, MFC, other sources, and fusing METOC and tactical information. The **JOAF**, ideally produced by the JMFU in collaboration with component METOC forces, is the overarching **operational planning forecast** for all joint force operations and will be used by all METOC forces. The JMO is the final authority to settle any disagreements on the JOAF. The JOAF will be used by tactical units to tailor execution forecasts at appropriate levels in the joint force. Figure IV-8 identifies the building block elements of JMFU operations.

With connectivity to other MFC production facilities for worldwide data and/or information, joint forces, and available indigenous assets for tactical data, the **JMFU normally has the greatest access to information** with which to produce METOC products meeting the requirements of the CJTF. Adequate communications and coordination between the JMO, joint forces, and MFC are required for effective METOC operations.

a. The JMFU **operates 24 hours per day** integrating and analyzing METOC information to assess the state of METOC conditions. Synthesis of this information results in the **planning forecast** for joint force METOC personnel to use when developing tailored METOC information for mission execution support. With this in mind, JMFU information, which can be packaged in different "product" formats, must be constructed with an understanding of **specific METOC thresholds** (restricted and/or unrestricted recommendation and/or decision matrix) that affect military capabilities and joint operations in the field. This requires **complete knowledge of the joint force operation**, the **overall objective**, and **specific METOC thresholds** that affect joint force component operations. This requirement will be difficult to achieve if the JMFU is not collocated with the CJTF. If the JMFU cannot collocate with the CJTF, a minimum requirement for the JMFU is to have **effective C4I connectivity** with the JTF to ensure a

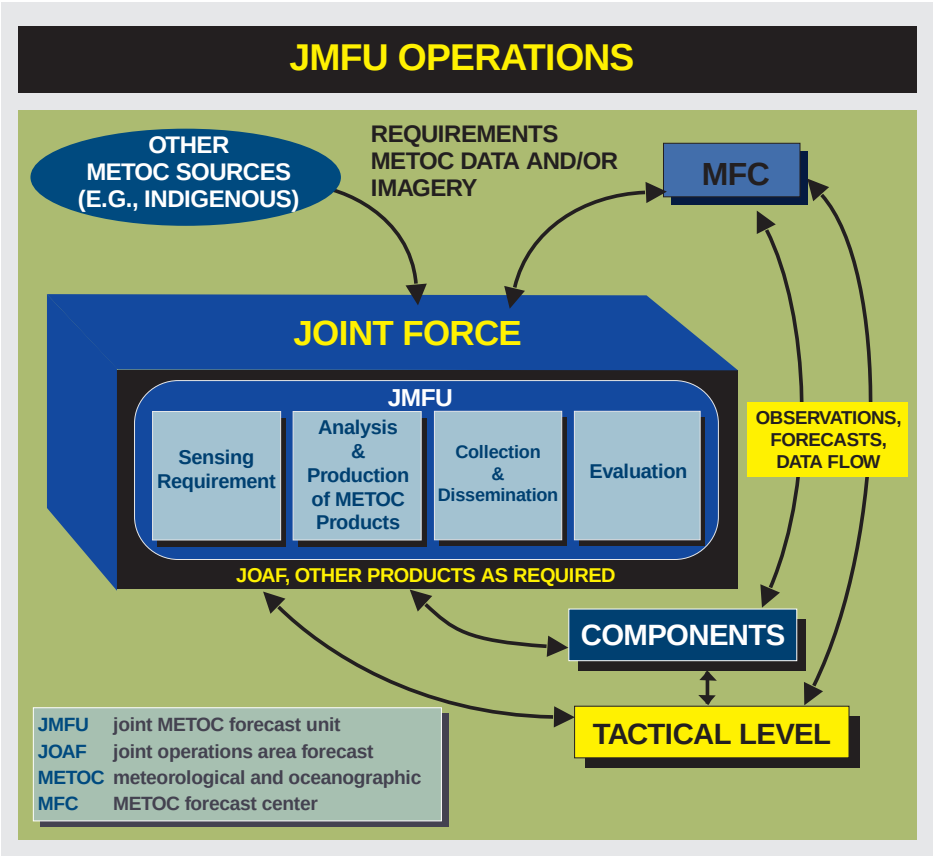


Figure IV-8. JMFU Operations

smooth flow of operations data necessary to produce accurate and timely METOC information.

b. **JOAF**. A primary JMFU forecast product is the JOAF. (See Appendix E, "Joint Operations Area Forecast," for example.) It provides a **detailed discussion and rationale** for the expected mean METOC conditions in the operating area for time periods required by the JTF. The JOAF may have several "sub" areas identified within the operating area to further tailor the METOC conditions expected (e.g., land forces area of operations, amphibious operations area, space environmental effects). The JOAF should specify **time of occurrence**, **duration** and **intensity** when certain METOC parameters are expected to exceed critical threshold values and impact joint force operations. This product is generally **disseminated to METOC forces on a regular basis** (usually every 12 hours). Since the JMFU is conducting a continuous watch of METOC conditions within the entire joint force area, they should amend the JOAF as required based on the thresholds that METOC tactical units identify and coordinate through the JMO. The JOAF is a **dynamic product** which adapts to and reflects the changing requirements of the operating area. As an example, predominately amphibious operations may transition to deep strike air operations. This clearly shows the need for the JMFU to be flexible in order to support the needs of the JTF while emphasizing coordination between all CJTF METOC forces to successfully orchestrate joint METOC support. Consideration should be given to including a section of the JOAF to cover an analysis and forecast of the space environment.

c. Other METOC information and/or products can be **developed, produced, and disseminated by the JMFU** as required. Current surface analyses, short and long-range significant weather depiction displays, low level hazard prognoses, point specific advisories, electro-magnetic decision aids, and electro-optical tactical decision aids (E-O TDAs) are just a few examples of information the JMFU can provide. Climatological support capabilities may also be available. Similar to the JOAF, these products are based on joint force requirements and should be amended as required. If required, the JMFU will develop tactical execution forecasts if provided with appropriate intelligence and targeting information.

d. Appendix F, "Examples of METOC Information Requirements and Responsibilities Within a Joint Force," is a list of the **majority of METOC information that would be required within a joint force**. Worldwide and regional computer-generated data grids which are "pushed" to the joint force in near real time from the MFC provide the baseline for much of the information listed. Within the joint force, however, tailored support evolves. Additionally, Appendix F, "Examples of METOC Information Requirements and Responsibilities Within a Joint Force," provides a framework and should be used to determine METOC organizational level responsibilities for tailoring individual parameters and developing specific products. Ideally, the division of labor and responsibility for the development and distribution of this information are addressed in OPLANs, CONPLANs, OPORDs, or LOIs. In the absence of a plan at the outset of a crisis, the JMO must work with the joint force components and the MFC to **review each information need** and **determine the responsible provider**. Careful evaluation should be conducted especially where functions are performed simultaneously in support of more than one operation or where Unified Command boundaries cross.

e. **METOC Data Management.** To meet the joint force's need for METOC information, the JMO focuses on **defining**

and submitting requirements and managing **METOC observing efforts**. The JMO should work closely with the SMO, JMFU, the CJTF staff, joint force components, and the MFC to ensure that the joint force METOC data collection plan supports the needs of the overall operation. For example, in addition to the receipt of conventional METOC observations and forecasts, the JMFU may require access to "unconventional" information (non-METOC assets) from intelligence sources, remote sensors, UAVs, reconnaissance patrols, and special operations teams. This additional information can greatly enhance both MFC modeling efforts and the JMFU production of specific forecast products for the JTF. If this information is required by the JMFU, the JMO must work closely with the JTF staff to ensure that the JMFU receives the information necessary to develop quality products.

f. **METOC Communications.** The JMFU will normally rely on the communications concepts outlined in Appendix J, "Communications," and Annex K of the OPLAN. The JMFU should establish a **transmission schedule** for their products (sent electronically and/or posted on a homepage) and **continually monitor** the overall effectiveness of their communications concept.

g. **Coordinating Instructions.** When activated, the JMFU should have direct liaison authorized with the other MFC elements and component METOC officers. Specific **OPLANs, OPORDs, or LOIs** should specify this overall guidance, including procedures to establish overall CJTF product priorities. The JMFU, under JMO direction, **should satisfy** (or arrange other support to satisfy) **all METOC requirements** which cannot be met by component capabilities. Joint forces should forward their METOC assistance requests (MARs) to the JMO. The JMO, in conjunction with the JMFU, will determine if the required information is within the JMFU's capability and, if not, will submit a support request to the appropriate MFC production facility. Additionally, if an MFC production facility has a requirement for specific information from within the operating area, it will submit requests to the JMO who will coordinate with the JMFU. If a different MFC serves as a backup to the JMFU, this requirement should be outlined in the CONOPS, OPORD, OPLAN, and/or LOI as appropriate to ensure that data is provided to the facility. Service specific information required at either the operational or tactical levels may be coordinated through the JMO and/or JMFU.

h. **JMFU Manning.** The JMFU should comprise the **proper Service component expertise** required to effectively support the joint force. The JMO will determine the composition of the JMFU in the planning process. The JMFU must be sized to support the operation and be **normally manned for 24 hour operations**. Appendix H, "Notional Joint METOC Forecast Unit Operation," describes a notional JMFU operation to support a major theater war (MTW) and can be modified to support a smaller scale contingency (SSC). Appendix H, "Notional Joint METOC Forecast Unit Operation," includes a list of duties and a minimum recommended manning level to execute these duties. Once developed, the JMFU must work with the JMO in identifying required augmentation of METOC personnel, systems, and communications to support requirements and for connectivity and interoperability between the combatant command SMO, the JMO, joint METOC forces, and the MFC.

i. **JMFU Equipment.** The SMO and JMO must consider how to equip the JMFU with the **METOC processing equipment and communications interfaces** it will need to carry out its functions. This equipment may already be available as organic capabilities or available as deployable assets which must be included in the TPFDD. Some basic

capabilities for consideration should include the following.

- Access to DOD and/or theater and component data command and control (C2) systems (e.g., GCCS, Global Command and Control System-Maritime [GCCS-M], Contingency Theater Automated Planning System, Army Battle Command System [ABCS] or Army Global Command and Control System). The Joint METOC Segment of GCCS can be installed on any Defense Information Infrastructure Common Operating Environment computing platform.

- METOC processing systems (e.g., Tactical Environmental Support System [TESS], Integrated Meteorological System [IMETS], METMF, New Tactical Forecast System [N-TFS], Navy Integrated Tactical Environmental System [NITES]).

- METOC dial-in systems and Worldwide Web Homepages (e.g., NODDS, AFWIN, SAFWIN, JWICS Air Force Weather Information Network [JAFWIN], SIPRNET and/or NIPRNET Homepages, Navy's JMV, 55th Space Weather Squadron [SWXS] Homepages).

- Local area network access to theater- and/or DOD-wide area network(s) (e.g., Defense Information Systems Network [DISN]).

- Weather networks (e.g., Automated Weather Network [AWN]).

- Meteorological satellite (METSAT) ground systems (e.g., USAF E-STT, USN SMQ-11, USMC METMF) that receive and process real time, high resolution meteorological imagery from polar orbiting and geostationary satellites worldwide.

- Theater servers for collecting, storing, and disseminating all-source weather information.

- Special weather intelligence (SWI) provided as classified reports on a regular basis through J-2 channels. Note that some SWI is available on electronic data broadcast systems such as tactical information broadcast service.

- Theater weather radar connectivity, integration, and dissemination capability.

- Theater-specific communications systems such as NATO Meteorological Information System.

j. **Security Issues. Classification of the METOC information and/or products should always be considered.** Although METOC information by itself is generally unclassified, products which specify particular operating areas or targets, unit locations, and critical operational thresholds may be classified. The JMO and JMFU should coordinate with the J-2 and J-3 on the overall classification guidance. Ensure that security containers are available for communications security (COMSEC) required equipment, if required.

6. Service and Functional Component Operations Within the Joint Force

Component METOC officers best know the unique capabilities their forces bring to combat and how those capabilities can help attain the JFC's objectives. They should also know how these capabilities mesh with the METOC forces of the other components. Organic METOC capabilities and/or operations are typically sized in support of

the Service and special operations component missions that were described in Chapter II, "Combatant Commands METOC Organizations." Component METOC officers provide **decision assistance** to their commanders and staffs and serve as the **focal point** for component METOC planning and execution. Based on the overall guidance from the SMO or JMO and their component's mission, **METOC officers plan, coordinate, and evaluate the METOC support requirements** for their component. The METOC officers should **document these requirements** in appropriate annexes to component level plans or LOIs for subordinate units' information. A key duty for METOC officers is to **determine information and products which are beyond their capability to provide**. This requires coordination with subordinate units. Each component can then determine what it can provide for subordinate operations and work with the JMO and JMFU for the support that the component cannot provide. Multiple component METOC resources within an operating area will collect METOC data in a coherent, unified sensing strategy (the METOC LOI should be used to facilitate the strategy). This data should be integrated to produce METOC products superior to any which an individual component could deliver. Other component and subordinate unit duties include: take and disseminate METOC observations, as required; prepare and disseminate METOC forecasts, to include weather watches and warnings, as required; operate METOC communications equipment; work METOC personnel and equipment problems; identify shortfalls in METOC personnel and equipment to their staff and JMO or SMO as applicable; and provide input to the TPFDD as required.

a. **AFFOR.** USAF METOC forces at the component, wing, and squadron use a combination of **surface observations, upper air data, weather satellite, weather radar, MFC and JMFU products, locally generated products, space environment data, and climatology** to provide tailored mission information. Tailored information includes observing, forecasting, and staff weather services. Information includes surface-based atmospheric observations (e.g., clouds, visibility, winds, pressure, temperature), upper-air observations (e.g., temperature, winds, and humidity), satellite data, and space environmental forecasts and/or observations (from 55th SWXS) for the area of interest. **USAF METOC personnel provide advisory and warning services, climatological information, and interpretation of meteorological and space environmental conditions and their impact on operations and personnel.** METOC personnel support planning and execution by providing information such as climatological data, tactical indices for weapon and/or sensor system employment, and tactical decision aids. Additionally, METOC personnel have the capability to deploy and use tactical equipment to measure and record atmospheric conditions and to transmit, receive, and manipulate data from the MFC, the JMFU, and weather satellite imagery. Descriptions of this equipment are in Appendix K, "Deployable METOC Equipment." In addition to USAF METOC support, METOC information can be gained from aviation TARWI reports and through the J-6 and the intelligence community. Air Force regional weather hubs and/or operational weather squadrons can provide theater-scale battlespace forecasts; drop zone, range, and/or air refueling forecasts; and fine-scale target forecasts as well as issue force protection weather warnings and terminal area forecasts for AFFOR and ARFOR locations within their operating area.

b. **ARFOR**

- Air Force METOC forces at the Army component and subordinate echelons provide **METOC information to Army forces** such as surface-based

observations (e.g., clouds, visibility, winds, pressure, temperature, ground conditions), upper-air observations (e.g., temperature, winds, and humidity), satellite data, and space environmental forecasts and/or observations. METOC personnel provide **battlefield and aviation forecasts, weather warnings and advisories, meteorological watch of target areas and air and ground avenues of approach, and interpretation of the effects of METOC conditions and their impact on operations and personnel**. METOC personnel support planning and execution by providing METOC information such as tactical indices for weapon and/or sensor system employment, tactical decision aids, and climatological information for long-range planning purposes. Air Force METOC personnel who deploy in support of ARFOR consist of CWTs that have the capability to use tactical equipment to receive satellite imagery, measure atmospheric weather parameters, and generate forecast products to provide this support. Appendix K, "Deployable METOC Equipment," provides descriptions of this equipment.

- In addition to USAF METOC support, **the Army provides two kinds of direct weather support to the Army combat mission**. First, **Army artillery meteorological crews provide surface and upper air observations** for artillery fire support. Second, **Army military intelligence personnel provide limited observations** from areas where Air Force weather teams are not manned, and typically do not operate. These observations can be from manned or automated sensors. Army personnel use tactical atmospheric sounding and observing equipment to provide this capability. This is further described in Appendix K, "Deployable METOC Equipment."

c. **NAVFOR**

- METOC data collection and assimilation capabilities and products and services provided to operating forces afloat are tailored **according to the requirements of the Commander of Navy Forces**. **Support consists primarily of METOC information and forecasts for operational use; forecast tactical indices for weapon and/or sensor system employment and tactical decision aids**; and **climatological information for long-range planning purposes**. OAs receive global and regional METOC data fields, alphanumeric (AN) data, satellite data and imagery, and local observational data. These data include high resolution Defense Meteorological Satellite Program (DMSP), National Oceanic and Atmospheric Administration (NOAA) and/or television infrared observation satellite (TIROS), geostationary satellite data, complete upper air sounding information, and ocean acoustic profiling. The OAs provide **tailored forecasts for safety and execution of operations, with tactical effects for weapons and sensors, by use of onboard prediction systems**. Appendix K, "Deployable METOC Equipment," describes these capabilities.

- Deployable and/or relocatable assets consist of METs. METs provide **short-term**, **deployable**, **on-scene METOC capabilities** (e.g., data collection, analysis, forecasting, tactical applications, climatology), normally to units and activities without organic METOC personnel. METs carry portable sensing, processing, and display equipment and have the capability to receive and display satellite imagery and theater METOC data broadcasts, as well as to run tactical application programs. METs are capable of setting up

automated weather systems at remote sites which sense temperature, humidity, pressure, and wind. Additional sensing capabilities includes upper air support, acoustic profiling, and remote data collection. Appendix K, "Deployable METOC Equipment," describes these capabilities.

- All Navy, Navy contract, and Coast Guard ships also take and report standard maritime weather observations, with or without embarked METOC personnel.

- Amphibious ships also provide surf forecasts for potential landing areas, supported by sea-air-land team surf observations.

d. **MARFOR.** Marine METOC support includes **surface-based atmospheric observations** (clouds, visibility, winds, pressure, temperature, precipitation) and **upper-air observations** (temperature, winds, and humidity) **for the area of interest**; **battlefield and aviation forecasts**; **weather warnings and advisories**; **meteorological watch of target areas and air and ground avenues of approach**; and **interpretation of the effects of METOC conditions on operations and personnel** (this support consists of METOC information and forecast tactical indices for weapon and/or sensor system employment and tactical decision aids; climatological services; and planning and staff advice). Marine METOC personnel who deploy have the capability to use tactical equipment to receive **satellite imagery, measure atmospheric weather parameters** (to include storm detection with weather radar), and **generate forecast products** to provide this support. MSTs from the MWSS will provide METOC support to the command element, ground combat element and combat service support element of the MAGTF. The MSTs will be equipped with the Interim Mobile Oceanography Support System (IMOSS) and a minifax capability, relying heavily on communications with the MWSS METMF. See Appendix K, "Deployable METOC Equipment," for equipment descriptions. In addition to Marine METOC support, artillery meteorological crews provide upper air observations for artillery fire support. Additional METOC information can be gained from aviation TARWI reports and from deployed reconnaissance forces via the intelligence chain of communications.

e. **Special Operations Component.** Air Force METOC personnel organized into SOWTs and Navy METs provide **direct support and information to SOF at the tactical level** using a combination of surface observations, upper-air data, weather satellite, weather radar, MFC and JMFU products, locally generated products, space environment data, and climatology. Tailored information provided includes **surface-based atmospheric observations** (clouds, visibility, winds, pressure, temperature), **upper-air observations** (temperature, winds, humidity, and refractivity) and **space environmental observations** for the area of interest; **advisories and warnings**; **climatological information**; and **interpretation of meteorological conditions on operations and personnel as well as planning** (this support consists of METOC information and forecasts for operational use; forecast tactical indices for weapon and/or sensor system employment and tactical decision aids; and climatological information for long-range planning purposes). These SOWTs and/or METs have the capability to deploy and use tactical equipment to measure and record atmospheric conditions and to transmit, receive, and manipulate data from the MFC, the JMFU, and imagery from weather satellites. They are equipped with a variety of Service and SOF-unique equipment to execute these capabilities.

7. METOC Forecast Center

The MFC consists of **Air Force and Navy worldwide production and climatology facilities and theater and/or regional**

METOC production facilities. The MFC supporting a joint operation is normally designated by the SMO or JMO in a LOI. The designated MFC will coordinate the efforts of all other MFCs to ensure that a full suite of products are available for use by the joint forces. The use of web technology is highly encouraged to build a virtual METOC data warehouse of support products. All production facilities perform critical activities that provide basic and applied METOC information to METOC forces and joint force operations. A designated MFC production facility may function as the JMFU during joint force operations. Selection of an MFC production facility to fill the JMFU role depends on location, capabilities, and communications connectivity. The production and climatology facilities provide worldwide METOC data and products. Most MFC production sites maintain homepage technology which may or may not require special identifications and passwords for access. JMOs and SMOs should maintain procedures for accessing MFC production site homepages as well as procedures for requesting specialized support. The regional and theater component level organizations provide tailored METOC information for a specific geographic area. Refer to Appendix M, "METOC Forecast Center," for a break-out of MFC capabilities. Examples of MFC products include:

a. Current analyses for global and hemispheric scales;

b. Forecast products for extended time periods and large geographic areas;

c. Point-specific data;

d. Climatological analyses for long-range operational and contingency support planning;

e. Space environmental analysis, forecast, and climatology products; and

f. Air Force operational weather squadrons produce mission-scaled tailored forecasts, point weather warnings and/or advisories, point forecasts for bases, drop zones, landing zones, and air refueling tracks, plus flight hazard products.

Intentionally Blank

APPENDIX A
SMO AND JMO INVOLVEMENT IN PLANNING

"Never in the history of warfare have weather decisions played such an important role in operational planning as they have here in Southeast Asia...."

General Creighton Abrams
Commanding General, Vietnam, USMACV, 1968

1. Overview

This appendix provides assistance to the SMO and JMO involved in planning a joint operation. The key to planning, whether for an exercise or real world operation, is early identification of specific support requirements.

a. **Planning Requirements.** These include but are not limited to transportation, logistics, communications, and information. The size, structure, and content of METOC support depends on the JFC's operational needs. METOC support will include integrating a mix of global, regional, and locally produced METOC products as well as data and products received from reliable foreign sources. METOC operations must be considered and included in long-range planning, mission planning, and operational execution. Figure A-1 is a flow diagram that can be used by the SMO or JMO in the development of the specific METOC plan.

b. **Planning Data and/or Climatology.** The study and application of historical METOC information is invaluable for planning, staging, and executing worldwide military operations. In many cases, and especially in the Third World, climatological data provides the only METOC data available. Such information includes, but is not limited to, summarized historical METOC information, derived environmental impacts on weapon systems, and tailored narrative studies. Exploiting this information can allow the warfighter to take advantage of favorable METOC conditions, minimize impacts of adverse conditions, or use unfavorable METOC conditions to gain advantage.

2. Joint Operation Planning and Execution System

The Joint Operation Planning and Execution System (JOPES) is the principal system within the Department of Defense for translating policy decisions into OPLANs and OPORDs in support of national security objectives. To accomplish this task, JOPES consists of a deliberate and a crisis planning process shown in Figure A-2. Deliberate planning is accomplished in five phases: initiation, concept development, plan development, plan review, and supporting plans. The deliberate planning process can take up to two years, but in reality is a continuous process. In crisis situations, planners follow established crisis action procedures. These procedures provide for the rapid and effective exchange of information and analysis, timely preparation of military COAs for consideration by the National Command Authorities (NCA), and the prompt transmission of NCA decisions to supported commanders. The impact and need for METOC information is important to the crisis action planning process and is outlined below.

a. **Situation Development.** When an event occurs with possible national security implications and a CINC's assessment is warranted, the SMO can provide valuable input to the CINC. This includes:

- Current METOC conditions (land, ocean, air and space) in the area of interest;

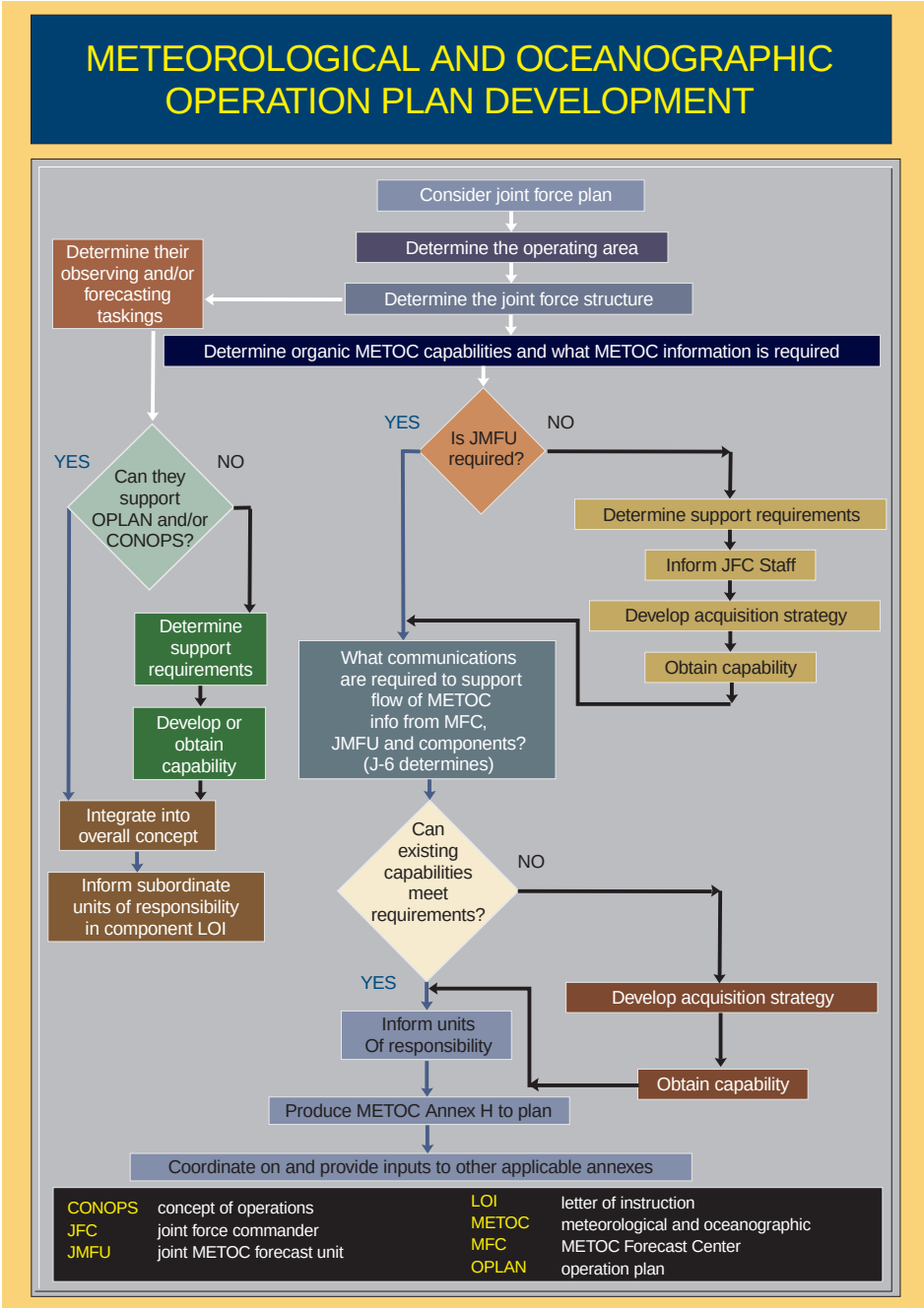


Figure A-1. Meteorological and Oceanographic Operation Plan Development

- Climatological factors;
- Forecast weather;
- Potential METOC impact on the event, to include suitability of sites for employment of forces; and
- Degree of accuracy and limitations of forecast products.

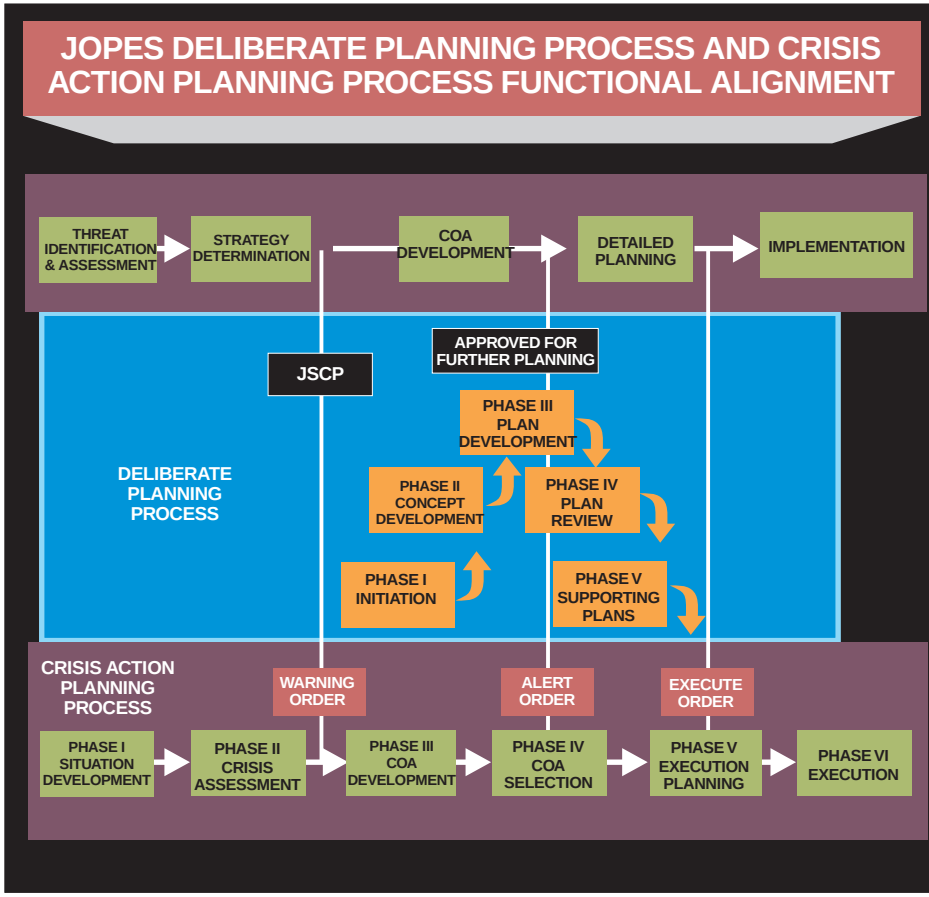


Figure A-2. JOPES Deliberate Planning Process and Crisis Action Planning Process Functional Alignment

b. **Crisis Assessment.** During CJCS assessment of the event and review of the CINC's Assessment, METOC support can aid in the determination of whether to initiate military action and how METOC conditions might impact potential military options.

c. **COA Development.** The arrival of the CJCS warning order denotes a critical phase for the SMO. Development of a realistic, efficient, and effective COA can be critically linked to METOC information. The tasking of subordinates to provide input to this process involves another layer of METOC officers that can significantly improve the METOC data base for the operating area. Appendix B, "METOC Information in Operation Plans," provides guidance on the METOC information requirements of the CINC's "Commander's Estimate" message.

d. **COA Selection.** This is the time for communication between the SMO, JMO (if identified), and Service component METOC planners who will provide the METOC personnel, equipment, and services judged necessary to fully support the planned operation.

e. **Execution Planning.** During this phase the OPORD is developed by modifying an existing OPLAN, expanding an existing CONPLAN, or building an OPORD from scratch. Appendix B, "METOC Information in Operation Plans," provides guidelines for the preparation of OPLAN Annex H, METOC

Services, and details other annexes requiring METOC input.

f. **Execution.** The JFC assembles the organization and implements the OPORD. Communication must continue between the SMO, JMO, and the Service components to facilitate problem solving and to ensure that the commander has a METOC organization appropriate to the mission.

APPENDIX B
METOC INFORMATION IN OPERATION PLANS

"It is always necessary to shape operation plans.....on estimates of the weather, and, as this is always changing, one cannot imitate in one season what has turned out well in another..."

Frederick the Great: Instructions for His Generals, iii, 1747

1. Overview

This appendix summarizes standard locations where METOC information is used within the JOPES. It is provided to aid the SMO and JMO in determining where and what METOC information can be integrated with other staff functions as the JFC's plan develops. JMOs should work with the appropriate J-staffs to ensure that METOC guidance and information provided in other functional annexes are complete and accurate.

Reference CJCSM 3122.03, "Joint Operation Planning and Execution System Vol II: (Planning Formats and Guidance)," for Annex formats and guidance on where METOC information should be included.

2. JMO Responsibilities

The JMO is responsible for METOC information commonly used in the intelligence estimate, the commander's estimate of situation, and OPLAN Annexes B, C, H, K, and N.

a. **Intelligence Estimate.** Accurate and timely METOC information can help in the formation of an accurate intelligence assessment. The intelligence estimate describes the topography, terrain, and approaches and exits from borders; natural obstacles; the nature of the coastline; adjacent islands; location, extent, and capacity of landing beaches and their approaches and exits; and the nature of the offshore

METOC information assists in the formation of an accurate intelligence estimate, including the nature of the offshore approaches.

approaches, including type of bottom and gradients; natural obstacles; and surf, tide, and ocean and/or water current conditions. The intelligence estimate requires METOC parameters such as temperature, humidity, cloud cover, visibility, precipitation, illumination data, and other METOC conditions to assess effects on roads, airfields, rivers, and soil trafficability. From these METOC specifications, geographic intelligence personnel can accurately gauge the METOC effects on enemy capabilities and possible COA for friendly and enemy forces.

b. **Commander's Estimate of the Situation.** The commander's estimate will include the characteristics of currents, tides, and similar maritime considerations, and determine and state extremes of temperature, wind velocities, cloud cover, visibility, precipitation, and other such factors that can affect all military operations. Sunrise and set, moonrise and set, civil, nautical, and/or astronomical twilight data, and moon percent illumination are also normally provided.

c. **Annex B, "Intelligence."** Annex B will summarize the hydrographic data (water depths, tides, wave height, and currents) needed to support amphibious and logistics over-the-shore operations. reference Annex H and any others (C, K, N, etc.) as required; include climatology and weather aspects as they pertain to the operational environment; and perform a thorough intelligence preparation of the battlespace from a METOC perspective.

Use JP 2-01.3, "Joint Tactics, Techniques, and Procedures for Joint Intelligence Preparation of the Battlespace," as a guide.

d. **Annex C, "Operations."** Annex C will summarize the general nature of METOC phenomena or conditions, with emphasis on those that could have an impact on the main and supporting efforts of the operation, as well as any planned deception actions.

e. **Annex H, "METOC Operations."** This is the SMO's and JMO's primary vehicle for describing the METOC operations within a joint force.

- List documents that provide information required for use with this annex.
- State the general concept of METOC support for the forces assigned to the OPLAN.

Amphibious assault operations heavily depend on hydrographic data.

- State the assumptions that affect the METOC operations required by the plan. Realistic estimates of the availability of data and facilities in the joint operations area, availability of support from non-US and US nonmilitary agencies, and the feasibility of obtaining METOC data from satellites will be included.

- Identify any significant METOC conditions that may influence the execution of the plan. The purpose of this paragraph should be to establish the requirement for any unusual METOC operations that will clarify the assignment of specific responsibilities. METOC factors that may influence operations and the probability of their occurrence will be included.

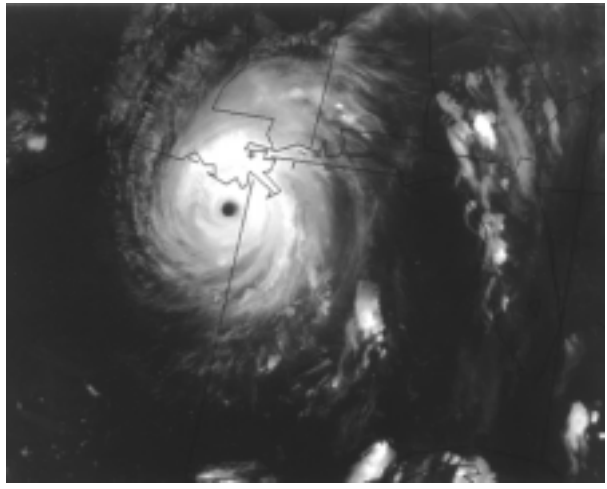
- State clear and concise METOC operation objectives in support of the plan.

- Describe the METOC support system and how it will function in the implementation of the plan. Refer to other documents available to tasked units that establish doctrine and procedures, as appropriate. Note any deviations from standard practices and any additional procedures peculiar to the operation.

- Identify the Service component(s) responsible for providing METOC support to the operation, including communications and production responsibilities for METOC information. Assign responsibilities to specific Service components. Ensure that operations security (OPSEC) planning guidance is included so as to not reveal indicators of friendly intentions. Clearly delineate for each applicable component or other subdivision of the force individual METOC services, tasks, and responsibilities. Ensure that severe weather notification procedures are outlined for each METOC agency throughout the AOR.

- **Coordinating Instructions.** Include the instructions common to two or more components or subdivisions.

- **Administration and Logistics.** Provide broad guidance on how logistic and administrative support is to be furnished for the METOC forces (a reference to the



Unusual METOC conditions can impact operations.

Solar activities can impair communication capabilities.

OPLAN's Annex D or other pertinent command directives may suffice.)

- **Command and Control.** Indicate the channels for control of METOC operations if different from the command relationships outlined in the basic plan or in Annex J. Provide instructions to cover periods when communication circuits are not operational. Provide instructions for transmitting METOC information to units where METOC or standard C2 circuits are not available. Provide instructions for denying METOC data and information to the enemy through implementation of control of meteorological information (METCON), oceanographic information (OCEANCON), ice information (ICECON), and space information (SPACECON). Provide a short description of strategic and tactical communications architectures that will be developed to support METOC data transmission and information flow.

  See JP 3-54, "Joint Doctrine for Operations Security," for further guidance on operations security issues.

f. **Annex K, "Command, Control, and Communications Systems."** Communications is an essential element of METOC operations. Because METOC data is extremely perishable, effective METOC operations are dependent on timely, reliable communications support. The joint communications architecture should support the collection or interception, storage and retrieval, dissemination, quality control, and processing of large amounts of data. High-speed communications are required to rapidly transmit and receive real-time global scale METOC information between the MFC, JMFU, component, and tactical units. Work with the J-6 to determine the overarching customer backbone communication architecture. METOC communications concept, procedures, and requirements to support METOC information flow throughout the joint force operating area should be included in this annex. Coordinate with J-6 on the development of the technical details in Annex K (e.g., network diagrams that identify all connectivities). In general, the METOC providers are subscribers to the DISN and to the tactical communication resources listed in Annex K. Annexes H and K will not list all of the communications resources used to

generate and disseminate METOC products. For example, a wide array of communications networks and serial connections are used to disseminate and share data among the participants of the data exchange agreements in the World Meteorological Organization and the US Office of the Federal Coordinator for Meteorological Services and Supporting Research. These nonsecure communication resources, although not part of the Department of Defense Information Infrastructure, are critical to the production centers. Special attention must be given to coordinating their inclusion into the communication architecture (Annex K to the OPLAN) to make sure the information is accessible.

g. **Annex N, "Space Operations."** Annex N provides a description of weather satellites and weather satellite terminals available to the AOR, along with a brief description of the capabilities these terminals provide. It mentions types and levels of possible degradation to communications, radar, and navigation systems due to solar, geomagnetic disturbances which can cause mission impacts. Commanders may require specific quantification of impacts at execution; this level of detail will be facilitated as METOC capabilities mature. Annex N will state how an operator can obtain assistance from the 55th SWXS to mitigate the problems to friendly forces or exploit the space environment to gain an advantage over adversaries. Optimally, this requires the SMO, JMO, and component METOC forces to be proactive on behalf of their customers in assessing space impacts.

Intentionally Blank

APPENDIX C
METOC LETTERS OF INSTRUCTION

1. Overview

This appendix identifies the type of guidance an SMO or JMO should communicate to joint force METOC and other operational forces via an LOI. An LOI may be published when an OPORD is not yet available or when additional information must be passed to lower joint echelons.

2. Contents

The JMO, or the SMO if the CINC has not yet established a JTF, should issue the initial LOI message based on information collected during the first stages of the deliberate and/or crisis planning process for an exercise or operation. The first message may not be a complete LOI and is intended to alert the METOC community of the forthcoming activity or assignment. Subsequently, if required, the JMO prepares a complete LOI message which details taskings and instructions for all aspects of METOC support. The LOI should be sent to all units in the joint force, supporting force commanders, and all supporting activities (i.e., MFC) and included as part of the METOC homepage on the SIPRNET (if available). This message should amplify information contained in Annex H of the OPLAN. Potentially, if an Annex H is not developed in support of a joint force operation, the LOI would provide the necessary information to synchronize METOC support. Information that is available in an Annex H is not expected to reappear in the LOI unless a change is required.

3. LOI Topics

The following is a comprehensive listing of topics that might be included in a METOC LOI message.

a. **Originator.** CINC, subordinate JFC, and/or delegated authority.

b. **Addressees.** All units in the force, supporting force commanders, and supporting activities, to include senior Service METOC personnel.

c. **Classification.** As appropriate.

d. **Subject.** Unclassified subject that includes exercise or operation name followed by "METOC LOI."

e. **Reference.** Reference all other supporting CONOPS, OPORDs, OPLANs, CONPLANs, and exercise plans.

f. **Points of Contact.** The SMO's and JMO's names and phone numbers should be indicated in this section.

g. **Purpose.** Provide a concise description of the purpose to be achieved by implementing the LOI.

h. **Situation.** Describe the situation that has created the need to establish a joint force METOC operation.

i. **Concept of METOC Operations.** State the general concept of METOC operations for the forces assigned to the OPLAN and any JMFU and MFC involvement. Describe the METOC system and how it will function in the implementation of the plan. Refer to Annex H and other documents available to tasked units that establish doctrine and procedures, as appropriate.

j. **Assumptions.** State the assumptions that affect the METOC operations required by the plan.

k. **Planning Factors.** State the significant METOC conditions that may influence the execution of the plan. Detail air, sea, and space climatology during operations.

l. **Mission.** Concisely state the METOC objectives in support of the JFC plan.

m. **Execution.** Provide the time period of expected operations, METOC staff locations, responsibilities for METOC information management, tasks and responsibilities, coordinating instructions, and operational constraints. Include an overall sensing strategy and/or plan as required. The following should be detailed.

- SMO responsibilities, duties, and location.
- JMO responsibilities, duties, and location.
- JMFU composition, equipment, location, products provided, product schedule, and communication capabilities.
- A list of MFC production facilities involved and their responsibilities.
- A list of METOC teams on functional and Service component staffs and their locations

n. **Deployment.** Provide the time METOC forces will be on station.

o. **OPSEC.** Describe OPSEC requirements.

p. **Coordination Instructions.** Provide instructions common to two or more components or subdivisions.

q. **Operational Constraints.** Provide restrictions due to manning, equipment, or other areas that might impact operations. In addition, issue guidance directing elimination of personnel and equipment duplication in both joint and Service echelons to reduce movement requirements and the footprint of deployed personnel.

r. **Administration and Logistics.** Provide broad guidance on how logistic and administrative support and/or requirements are to be furnished for METOC operations (if not already documented in a related OPLAN Annex H).

s. **Equipment and Supplies.** List equipment requirements for the functional component METOC teams and/or staffs and expendable supply requirements.

t. **Command and Control.** Summarize the command relationships applicable to the conduct of the operation.

u. **METCON, OCEANCON, ICECON, and SPACECON.** Provide instructions for implementation as required by JFC.

v. **Communications.** Detail communications guidance to include METOC data flow into and out of the joint force operating area. Address homepage availability and access procedures, NIPRNET and/or SIPRNET connectivity and address list, high frequency (HF) regional broadcast (HFRB), fleet HF FAX broadcast, HF METOC net availability, and products. Designate "KQ" identifiers for METOC units as required.

w. **Reporting.** Detail METOC report requirements (e.g., after action reports, equipment status, product assessments) including content and delivery times.

x. **METOC Assistance Requests.** Provide guidance for requesting special METOC products not in normal distribution through MARs.

APPENDIX D
METOC DATA SOURCES FROM NON-METOC OPERATIONS

"In modern warfare, any single system is easy to overcome; combinations of systems, with each protecting weak points in others and exposing enemy weak points to be exploited by other systems, make for an effective fighting force."

Vice Admiral Stanley R. Arthur
Commander, US Naval Forces, Central Command
Operation DESERT STORM

1. Overview

This appendix summarizes METOC data that is available from sources other than ongoing METOC operations described in Chapter IV, "Joint Force METOC Operations." This additional data is critical to supplementing the METOC data base from which the various METOC echelons derive forecast products.

Special Weather Intelligence available through intelligence sources is described in JP 2-01, "Joint Intelligence Support to Military Operations."

2. ARFOR

In addition to the weather operations provided by the Air Force, the Army has organic resources which provide supplemental reports of METOC conditions. These Army elements possess a limited measuring capability designed to meet their own immediate needs. Consequently, their METOC observing capabilities are supplemental to their primary mission. They should not be viewed as a replacement or substitute for Air Force METOC operations. Since Army units are mobile, locations must be included as part of the METOC report; consequently, the Army requires these reports to be classified and transmitted over secure communications channels. Within the Army structure, secure METOC communications travel either over HF radio (IMETS and/or quick reaction communications terminal [QRCT] III) or mobile subscriber equipment (MSE), or SIPRNET systems to the highest Army echelon. This echelon will relay the data to the JMFU via available secure means. The following represents the most significant sources of weather data within the Army tactical structure.

a. **Artillery Meteorological (ARTYMET) Sections**

- ARTYMET teams are assigned to, and deploy with divisions and separate field artillery brigades. In general, the ARTYMET teams provide upper-air observations and artillery limited surface observations; however, meteorological support varies with the mission of the Army unit. Specialized meteorological teams can be deployed to support missions as needed. For instance, the need for fallout meteorological messages requires that one meteorological section be designated to produce fallout data.

- Geographical locations of the meteorological sections will vary with atmospheric conditions, communications capabilities, administrative support, and local security as well as artillery unit location.

- **Data Collection Capabilities**

•• ARTYMET sections are equipped to perform upper-air observations employing a balloon-sounding method. These sections can electronically sound the atmosphere and provide upper-air winds, temperatures, and densities to heights of 98,424 feet (30,000 meters), day or night, and in all types of weather except during severe surface winds. If electronic equipment fails, they have an alternate, but limited, method of measuring upper-air winds by visually observing pilot balloons. A limiting factor is the time required for a sounding balloon to reach its required height (normally 2 hours to reach 30,000 meters). However, the sections are capable of sounding the atmosphere every 4 hours and, once in position, can produce a ballistic message for light artillery within 30 minutes after releasing the balloon.

•• ARTYMET sections can produce the following: computer meteorological messages, fallout messages, upper-air data, target acquisition meteorological messages, and limited surface weather observations.

- **Communications Capabilities**

•• At the Corps level, the sections are normally equipped with frequency modulation radio and MSE communications for verbal and data exchange capabilities. Meteorological data can be acquired by monitoring this net at specified times.

•• At the Division level, units may obtain meteorological data over the division artillery fire direction radio net, and through Tactical Fire Direction Computer System automatic data processing (ADP) systems.

b. **Air Traffic Control (ATC) Units.** ATC units may have weather-observing instruments to include measurement of surface pressure, temperature, and surface wind velocity and direction. In addition, aircrews, flight operations personnel, and control tower operators visually estimate horizontal visibility and obstructions to visibility. They also observe such special phenomena as lightning, thunderstorms, and tornadoes. Control tower operators assigned to ATC units are trained by Air Force METOC personnel to make limited weather observations.

c. **Engineer Units.** The engineers can provide stream flow measurements and predictions of river stages and floods.

d. **Ground Reconnaissance and Surveillance Elements.** Cavalry units provide the Corps and Division principal ground reconnaissance capability. Cavalry and maneuver battalions have organic ground reconnaissance capability that may be used to obtain information related to weather, terrain, and overall environmental conditions requested by the intelligence staff officer (G-2 and/or S-2). In addition, long-range surveillance units at Division and Corps may be required to take weather observations deep across the forward line of its own troops based on specific weather requirements meeting the given situation.

e. **Imagery Interpretation Elements.** These units can provide information on visibility, cloud cover, trafficability, and flooding.

f. **Armored Cavalry Regiment (ACR), Brigade, Battalion, and Squadron Intelligence Personnel.** ACR, brigade, battalion, and squadron intelligence officers are tasked by the G-2 to provide supplemental weather observations. The frequency of observations depends on the intelligence preparation of the battlespace process which identifies critical areas where adverse weather may have a major impact on land force operations, weapons, personnel, and tactics.

Reconnaissance personnel can take weather observations deep into enemy territory.

High priority must be placed on these messages to transmit them immediately to the Air Force staff weather officer (SWO) at the Division, Brigade, or Regimental Main Command Post.

g. **Supplemental Weather Observations Taken by Army Personnel.** Doctrinally, the Army is responsible for collecting weather and environmental data from areas in which Air Force METOC personnel are not manned, trained, or equipped to operate. To accomplish this, the Army provides supplemental observations under FALOP. The lower echelon S-2 transmits the supplemental observations promptly to higher headquarters. These observations require a high priority to ensure transmission within 15 minutes of the time they are taken. The G-2 specifies the supplemental observation requirement and ensures that these observations flow directly to the USAF CWT, which handles further distribution. The supplemental observations serve as the basis for the G-2 and SWO to determine the effects of adverse weather on Army systems, operations, and tactics. The CWT incorporates supplemental observations with all other sources of information, when they are available, to make a complete weather picture of the battlefield at the time of the observation. In some cases, the supplemental observations may be the only source of observations in forward areas and are the key to forecasts tailored to the user's needs. The collected data in a supplemental weather observation taken by Army personnel may include measurement of temperature, wind direction and speed, cloud information, visibility estimate, type of precipitation and intensity, atmospheric pressure, and road, ground, and water conditions.

h. **Aviation Squadrons and/or Brigades.** Aircrews provide en route pilot reports via radio to ATC units and/or USAF CWTs; or, upon return from the flight, to the USAF CWT operating location for use in developing their forecast products.

i. **Space Support Teams.** The Army obtains some space environmental information from satellite operations squadrons and Army space support teams as well as outside sources, such as universities and research facilities.

3. NAVFOR

a. The following represent the most significant sources of METOC data within the Navy tactical structure.

- Battle Force Surface Ships
- Carrier Air Wing
- Maritime Patrol Aircraft
- Submarines
- Naval Air Stations and/or Facilities

METOC observations taken by these units consist of surface weather, upper air, PIREPs, and bathythermograph (BT) data.

b. **Battle Force Surface Ships.** All battle force and/or group surface combatants (aircraft carriers, cruisers, destroyers, frigates, amphibious, mine warfare, and logistic support ships) provide METOC surface weather observations every 6 hours while at sea. These reports are submitted on the synoptic hours of 0000Z, 0600Z, 1200Z, and 1800Z. If the winds exceed 35 knots or the seas exceed 12 feet, then the reporting rate increases to a report every 3 hours until the winds and/or seas decrease to below these limits. All ships at sea are required to take regular observations, but where ships are steaming in company or in close proximity, the officer in tactical command may designate one ship to report for the group.

- All antisubmarine warfare (ASW) ships (cruisers, destroyers, and frigates) collect BT data by dropping an expendable temperature sensor into the sea. Operational requirements drive the collection rate of BT data.
- Upper-air observations are regularly collected by those Navy vessels with a permanently assigned OA or embarked MET. Upper-air observations are routinely taken twice per day and targeted for the synoptic times of 0000Z and 1200Z.

c. **Carrier Air Wing.** Aircrews provide meteorological observations and PIREPs as specified by their mission, or when required in areas of sparse data. PIREPs are submitted via radio or upon return from the flight to the carrier weather office for inclusion in their forecast products.

Navy surface ships take routine weather observations.

d. **Maritime Patrol Aircraft.** Aircrews provide meteorological observations as specified by their mission, or when required in areas of sparse data. Aircraft observations are transmitted when radio contact is made, or are delivered (along with observations of unexpected en route weather), to the Naval Meteorology and Oceanography Command (NAVMETOCCOM) activity at the air station at which the aircraft lands. BT observations shall be taken by sonobuoy equipped aircraft in open ocean areas where depths exceed 100 fathoms. A minimum of one BT observation shall be taken during each ASW flight which uses sonobuoys. All collected data will be submitted to the NAVMETOCCOM activity at the air station at which the aircraft lands.

e. **Submarines.** Submarines are capable of, and can be tasked with, collecting surface weather and BT observations. They will take and report these observations unless operational requirements preclude them from doing so.

f. **Naval Air Stations and/or Facilities.** METOC personnel at these sites provide surface observations, upper air soundings, and terminal aerodrome forecasts.

g. **Space Support Teams.** The Navy obtains some space environmental information from satellite operations squadrons and Navy space support teams as well as outside sources, such as universities and research facilities.

h. Communication procedures for METOC observations include locations; therefore, the Navy requires these reports to be classified to protect ship and aircraft operating locations. All METOC observations collected by the Navy are forwarded to the collective address designator (CAD) "OCEANO WEST" or "OCEANO EAST." These CADs distribute observations to the Fleet Numerical Meteorology and Oceanography Center (FLENUMMETOCCEN), Monterey, California, Naval Oceanographic Office (NAVOCEANO), Stennis Space Center, Mississippi, and Air Force Weather Agency (AFWA) for use in their forecast models and for further distribution to all Naval fleet units requiring observation data. The CAD's OCEANO EAST and OCEANO WEST include theater METOC centers. OCEANO EAST contains the Naval European Meteorology and Oceanography Center (NAVEURMETOCCEN ROTA SP)

Submarines are capable of collecting METOC information.

and the Naval Atlantic Meteorology and Oceanography Center (NAVLANTMETOCCEN NORFOLK VA). OCEANO WEST includes the Naval Pacific Meteorology and Oceanography Centers in Pearl Harbor, Guam, Yokosuka, San Diego, and Bahrain (NAVPACMETOCCEN PEARL HARBOR HI, NAVPACMETOCCEN WEST GU, NAVPACMENTOCCEN YOKOSUKA, NAVPACMETOCCEN SAN DIEGO, and NAVCENTMETOCCEN BAHRAIN, respectively).

4. AFFOR

The most significant non-METOC Air Force sources of weather data are aircrews. This is often in the form of PIREPs and air reports, or the information is contained in the TARWI report. ATC teams have limited observation capabilities. Also, the Air Force obtains some space environment information from satellite operations squadrons as well as outside sources, such as universities and research facilities.

5. MARFOR

Marine ARTYMET sections provide meteorological data for artillery firing units in the same manner as the Army. They also provide upper-air observations and artillery surface observations which can be added to the overall METOC data base. Marine Corps aircrews are tasked with providing TARWI reports and PIREPs. Limited observations are available from reconnaissance forces through intelligence channels. ATC detachments also have wind and pressure sensors.

6. Special Operations

Depending on the size and composition of the forces, special operations components will deploy with similar capabilities to their equivalent conventional Service components. Army and Air Force special operations aviation units can provide PIREPs and TARWI reports from missions into denied areas. Forward area weather observations can be taken by special forces teams, special operations combat control teams, special operations weather teams, and Ranger units in denied areas and transmitted to the JSOTF on an irregular basis. Naval special warfare task units can provide beach profile data as well as surf zone observations. Although this data is required by the JMFU to help them build a coherent METOC picture, JMOs must be sensitive to OPSEC considerations when incorporating this data into their theater sensing strategy.

TARWI information from aircrews are an integral part of determining battlefield weather conditions.

APPENDIX E
JOINT OPERATIONS AREA FORECAST

"People have to fight in war on all sorts of days, and under all sorts of conditions..."

Winston Churchill
14 Aug 1940

1. Overview

This appendix provides an example of the type of information that the JOAF could provide and the details which need to be worked by the JMO, JMFU, and the joint force components. The JOAF, as approved by the JMO, is the official planning forecast for all components of the joint force. It is issued at the JFC level to ensure that all components are aware of what the JFC is using to plan the coordinated battle. Significant deviations from the JOAF will be coordinated with the JMO. Components and individual units will use the JOAF as the point of departure to tailor METOC information and to develop tailored mission execution forecasts. The JOAF may include a forecast data base when needed for tactical decisions used in planning.

2. Example of a JOAF

a. **Part 1. Current and Projected Situation Discussion.** This discussion integrates synoptic, upper-air, and METSAT information; highlights influences on, or potential for, any forecast significant surface or upper-air weather in the joint operations area (JOA); and provides cumulative summary and assessment for weather of continuing duration (e.g., strong winds, continual rainfall for flooding potential, or lack of rain for drought conditions).

b. **Part 2. 0-24 Hour Forecast.** This forecast will detail and/or partition area(s) affected within the JOA as required (identify affected ranges, air refueling tracks, etc.); briefly summarize and/or characterize model initialization (e.g., "good, but slightly fast"); and provide 0-24 forecast of the following criteria.

- Clouds (amounts, bases and/or tops).
- Upper-air significant weather and/or level(s) (turbulence, icing, thunderstorms). Moderate and severe intensities are key.
- Surface significant and/or sensible weather (winds, thunderstorms [and hail w/size, if applicable], rain). Surface winds (or gusts) >= 35 knots are usually considered a key threshold.
- Sea state (surf levels, tides, water temperatures, turbidity) as required.
- Surface visibility.
- Surface temperatures (highs and/or lows) with wind chill or heat indices, as appropriate. -20ºF and below is a key level for wind chill, and 105ºF and above is key for heat index.
- Minimum altimeter setting.

c. **Part 3. 24-72 Hour JOA Outlook.** By exception only. If no change, so state.

d. **Part 4. 3-5 Day JOA Outlook.** By exception only. If no change from 24-72 hour outlook, so state.

Intentionally Blank

APPENDIX F
EXAMPLES OF METOC INFORMATION REQUIREMENTS AND RESPONSIBILITIES WITHIN A JOINT FORCE

EXAMPLE OF AIR REFUELING FORECAST PARAMETERS		
Parameter	**Elements**	**Key Threshold**
Clouds	Amount, type, bases and/or tops	Any ceiling at flight level
Visibility	Flight level visibility (nautical miles [NMs])	Visibility < 1 NM
Thunderstorms	Coverage and maximum tops	Any occurrence
Icing	Type, bases and/or tops	Moderate or greater
Turbulence	Type, bases and/or tops	Moderate or greater

Figure F-1. Example of Air Refueling Forecast Parameters

EXAMPLES OF METOC INFORMATION REQUIREMENTS AND RESPONSIBILITIES WITHIN A JOINT FORCE			
Information (see instructions at end of Appendix)	**JMFU/ MFC**	**Functional or Service Component**	**Tactical Level**
Air Refueling Track Forecasts			
Altimeter			
ASW Products (Acoustics, Bottom Cond., etc.)			
Ballistic Winds			
Bathythermograph and/or Sound Profiles			
Ceilings and/or Cloud Layers a/o Bases and Tops			
CHAFF Forecast			
Chemical Downwind Message			
Cloud Free Line of Sight Forecasts			
Clouds			
Computerized Flight Plan			
Contrails			
Currents, Speed, and Direction			
Customer Threshold Forecasts			
D-Values			
Deep Layer Mean Winds			
Ditch Headings			
Drop Zone and Landing Zone Forecasts			
Ducting and/or Refractivity Index			
EO-TDA and/or Automated			
Forward Looking Infrared (IR) Forecast			
Freezing Level			
Fronts and Eddies			
Geomagnetic Conditions			
HF, Radar, and/or Radio Propagation Forecasts			
High Resolution Forecast Database			
High Seas Warnings			
Horizontal Weather Depiction			
Ice Edge and/or Bergs			
Ice and/or Snow Coverage			
Icing			
Ionospheric Scintillation			
IR Thermal Crossover Times			
IR Transmissivity			
Integrated Refractive Effects Prediction System			
Jet Stream (Location and Strength)			
Joint Operations Area Forecast			
Lighting Detection			
Longwaves, 500mb			
Moisture and/or Humidity			

Figure F-2. Examples of METOC Information Requirements and Responsibilities Within a Joint Force

EXAMPLES OF METOC INFORMATION REQUIREMENTS AND RESPONSIBILITIES WITHIN A JOINT FORCE (cont'd)			
Information (see instructions at end of Appendix)	**JMFU/ MFC**	**Functional or Service Component**	**Tactical Level**
Nighttime Illumination			
Optimum Track Ship Routes			
Pilot Weather Reports			
Precipitation (Type and Amount)			
Radar Observations			
Relative Humidity and/or Moisture Fields (Sfc-10,000 ft)			
Sea Surface Conditions			
Search and Rescue			
Severe Weather Advisory and/or Forecast			
Shore Conditions			
Shortwaves, 500mb			
Soil Surface Temperature			
Soil and/or Ground Moisture Fields (6 in. depth)			
Solar Activity			
Solar Wind Conditions			
Sound Focus			
Surf Forecasts			
Synoptic Charts			
Synoptic Discussions			
Temperature Forecasts (Max and/or Min, etc.)			
Terminal Aerodrome Forecasts			
Tidal Data			
Thickness, 1000-500mb			
Thunderstorms			
Tropical Storm Advisories			
Tropopause Heights and/or Winds			
Upper Air Charts			
Upper Air Observations			
Upper Trop Mean Winds			
Visibility			
Vorticity (500mb)			
Winds			
Weather Observations			
Wet Bulb Globe Temperature Index			
Turbulence			
Windshear			

Use of this Appendix:

1. Use the above items as a list of parameters in which one or more of the METOC agencies listed above may have a need or interest. Mark which agency or agencies would have an interest in a specific METOC parameter.
2. The above list is not intended to be all-inclusive, but to serve as a memory-jogger when establishing METOC information requirements. Feel free to copy it and use as is, or to fold it in as part of your Annex H and OPORD writing process.

Figure F-2. Examples of METOC Information Requirements and Responsibilities Within a Joint Force (cont'd)

Intentionally Blank

APPENDIX G
METOC IMPACTS TO SELECTED OPERATIONS

METOC IMPACTS TO SELECTED OPERATIONS			
OPERATION	**FAVORABLE (No Degradation) (GREEN)**	**MARGINAL (Some Degradation) (AMBER)**	**UNFAVORABLE (Significant Degradation) (RED)**
ARFOR OPERATIONS			
BRIDGING	WIND < 10 KTS	WIND 10-34 KTS	WIND > 34 KTS
ARMOR GUN SIGHTS	VIS > 2000 m	VIS 1000-2000 m	VIS < 1000 m
TOW MISSILE	VIS > 3000 m	VIS 2000-3000 m	VIS < 2000 m
HELICOPTER (LIFT)	CIG > 500 FT	CIG 300-500 FT	CIG < 300 FT
(no specific airframe)	VIS > 1600 m	VIS 800-1600 m	VIS < 800 m
	NO ICG/TURBC	LGT OR MDT	SVR TURBC/ICG
		TURBC OR ICG	
HELICOPTER (ATTACK)	CIG > 2600 FT	CIG 1100-2600 FT	CIG < 1100 FT
(no specific airframe)	VIS > 4000 m	VIS 1000-4000 m	VIS < 1000 m
	WIND < 25 KTS	WIND 25-50 KTS	WIND > 40 KTS
			TEMP > 90F
	NO PRECIP	MDT PRECIP	HVY PRECIP
	NO Thunderstorms	FEW Thunderstorms	SCT Thunderstorms
HELLFIRE MISSILE	CIG > 2000 FT	CIG 800-2000 FT	CIG < 800 FT
	VIS > 5000 m	VIS 3000-5000 m	VIS < 3000 m
CLOSE AIR SUPPORT	CIG > 2000 FT	CIG 1000-2000 FT	CIG < 1000 FT
(For Army Planning Purposes)	VIS > 8000 m	VIS 3200-8000 m	VIS < 3200 m
AERIAL RECON	< 2/8 CLD COVER	2/8-4/8 CLD COVER	> 4/8 CLD COVER
	VIS > 8000 m	VIS 4800-8000 m	VIS < 4800 m
	Aerial Recon covers three levels — Strategic (above 25,000 ft), High (8,000 - 25,000 ft), and Low (below 3,000 ft). Cloud cover is for at or below flight (operating) level.		
GROUND RECCE	VIS > 3000 m	VIS 1000-3000 m	VIS < 1000 m
PARADROP	WIND < 13 KTS	WIND 13-18 KTS	WIND > 18 KTS
			CIG < 1000 FT
		LGT PRECIP	MDT/HVY PRECIP
	DA < 4000 FT	DA 4000-6900 FT	DA > 6900 FT
	(DA = Density Altitude)		
NBC OPERATIONS		WIND < 10 KTS	WIND > 30 KTS
			WIND CALM
			Wind From Enemy
	Stable Atmosphere	Neutral Stability	Unstable Atmosphere
	NO PRECIP	LIGHT PRECIP	MDT/HVY PRECIP
SMOKE		WIND 5-10 KTS	WIND < 5 KTS
			WIND > 19 KTS
			Wind From Enemy
			TEMP > 120 F
		MDT PRECIP	HVY PRECIP

Figure G-1. METOC Impacts to Selected Operations

METOC IMPACTS TO SELECTED OPERATIONS (cont'd)			
OPERATION	**FAVORABLE (No Degradation) (GREEN)**	**MARGINAL (Some Degradation) (AMBER)**	**UNFAVORABLE (Significant Degradation) (RED)**
ARFOR OPERATIONS (cont'd)			
PERSONNEL	NO PRECIP	LIGHT PRECIP	MDT PRECIP
(temp — heat and/or wind chill indices)	> 20F and < 85F	85-95F or -15 to 20F	> 95F or < -15F
Lock On Before Launch	CIG > 1900 FT	CIG 400-1900 FT	CIG < 400 FT
	VIS > 7000 m	VIS 500-7000 m	VIS < 500 m
Lock On After Launch	CIG > 1700 FT	CIG 800-1700 FT	CIG < 800 FT
	VIS > 7000 m	VIS 1700-7000 m	VIS < 1700 m
COPPERHEAD	CIG > 3000 FT	CIG 1000-3000 FT	CIG < 1000 FT
	VIS > 2500 m	VIS 1000-2500 m	VIS < 1000 m
	NO PRECIP	MDT PRECIP	HEAVY PRECIP
SEA PORTS	WIND < 20 KTS	WIND 20-35 KTS	WIND > 35 KTS
AIR PORTS	CIG > 1500 FT	CIG 200-1500 FT	CIG < 200 FT
	VIS > 4800 m	VIS 900-4800 m	VIS < 900 m
AIR DEFENSE	CIG > 5000 FT	CIG 2500-5000 FT	CIG < 2500 FT
	VIS > 5000 m	VIS < 5000 m	
			TEMP > 120F
ARTILLERY FIRES	CIG > 1500 FT	CIG 600-1500 FT	CIG < 600 FT
	VIS > 3000 m	VIS 1000-3000 m	VIS < 1000 m
	WIND < 30 KTS	WIND 30-35 KTS	WIND > 35 KTS
			TEMP < 20F
			TEMP > 125F
	NO TO LGT PRECIP	MDT PRECIP	HVY PRECIP
SIGINT	WIND < 30 KTS	WIND 30-45 KTS	WIND > 45 KTS
		TEMP 85-120F	TEMP < 32 F
			TEMP > 120F
TRAFFICABILITY	NO PRECIP	MDT PRECIP	HVY PRECIP
AFFOR OPERATIONS			
AIRLIFT	CIG > 1000 FT	CIG 500-1000 FT	CIG < 500 FT
(no specific airframe)	VIS > 8000 m	VIS 4800-8000 m	VIS < 4800 m
		Light Freezing Precip	Freezing Precip which closes runway
FLIGHT OPERATIONS	CIG > 3500 FT	CIG 1000-3500 FT	CIG < 1000 FT
(CAS and/or DEEP ATTACK)	VIS > 3200 m	VIS 1600-3200 m	VIS < 1600 m
(no specific airframe)	WIND < 25 KTS	WIND 25-35 KTS	WIND > 35 KTS
		LTG-MDT TURBC	SVR TURBC
ELECTRO-OPTIC SUPPORT	CIG CLR-SCT	CIG BKN	CIG OVC
(Absolute Humidity Limitations)	< 14 g/m3	14-18 g/m3	> 18 g/m3
(Transmittance)	> .4	0.2-0.4	< 0.2
(Moon Illumination)		Moonrise/Moonset	No Moon
(no specific system)			HVY PRECIP

Figure G-1. METOC Impacts to Selected Operations (cont'd)

METOC IMPACTS TO SELECTED OPERATIONS (cont'd)			
OPERATION	**FAVORABLE (No Degradation) (GREEN)**	**MARGINAL (Some Degradation) (AMBER)**	**UNFAVORABLE (Significant Degradation) (RED)**
AFFOR OPERATIONS (cont'd)			
PREDATOR	CIG > 2000 FT	CIG 800-2000 FT	CIG < 800 FT
	VIS > 4800 m	VIS 3200-4800 m	VIS < 3200 m
	Crosswind < 10 KTS	Crosswind 10-15 KTS	Crosswind > 15 KTS
AIR REFUELING	NO CLOUDS AT FLIGHT LEVEL	SCT-BKN CLOUDS AT FLIGHT LEVEL	OVERCAST CLOUDS AT FLIGHT LEVEL
	NO Thunderstorms	FEW Thunderstorms	SCT Thunderstorms
NAVFOR OPERATIONS			
AMPHIBIOUS WARFARE	CIG > 5000 FT	CIG 300-5000 FT	CIG < 300 FT
	VIS > 4800 m	VIS 1000-4800 m	VIS < 1000 m
LANDING CRAFT			
(Combined Seas)			> 5 FT
(Percent Illumination)			> .0001 FT CANDLES
(Moderate Surf Index)	< 8	8-10	> 10
(Breaker Heights)	< 5 FT	5-12 FT	> 12 FT
(Wake Period)	> 7 SECONDS	6-7 SECONDS	< 6 SECONDS
ANTI-SURFACE WARFARE			
Over the Horizon — Targeting	NO/LGT PRECIP	MDT PRECIP	HVY PRECIP
			TEMP > 103F
(Seas)	< 6 FT	6-8 FT	> 8 FT
			WIND > 60 KTS
COMBAT SERVICE SUPPORT			VIS < 400 m
(Combined Seas)	< 12 FT	12-19 FT	> 19 FT
MINE WARFARE AVIATION			CIG < 300 FT
			VIS < 1000 m
	WIND < 25 KTS	WIND 25-35 KTS	WIND > 35 KTS
EOD DIVERS		CURRENT 1-2 KTS	CURRENT > 2 KTS
(Combined Seas)	< 3 FT	3-5 FT	> 5 FT
HUNT	WIND < 20 KTS	WIND 20-30 KTS	WIND > 30 KTS
(Combined Seas)	< 3 FT	3-5 FT	> 5 FT
SWEEP	< 3 FT	3-6 FT	> 6 FT

Compiled from a combination of manuals, including FM 34-81, FM 34-81-1, Service manuals, and various equipment technical orders to present a general picture of METOC impacts to operations. This list is not all-inclusive, nor is it intended to restrict SMOs and/or JMOs to these limitations. SMOs and JMOs should feel free to use this list as a baseline, expanding or changing it as needed to suit the forces and limitations of their various commands.

Figure G-1. METOC Impacts to Selected Operations (cont'd)

Intentionally Blank

APPENDIX H
NOTIONAL JOINT METOC FORECAST UNIT OPERATION

1. Overview

This appendix provides a notional JMFU organization with associated tasks in support of a joint force operation.

2. Considerations and Assumptions

a. JMFU planning assumes that a robust METOC organization is required for an MTW. Less manning could be required for a SSC or military operations other than war (MOOTW).

b. Planners must consider C4I data base location and ease of communications with joint METOC forces when determining JMFU organization, size, and location.

c. Manning assumes long-term event — contingency manning (no days off) would require less.

d. Personnel are trained on JMFU functions and equipment prior to initiation of JMFU.

3. Manning

a. In a JMFU production facility, manning consists of in-place assets and other Service augmentation to fill-out expertise requirements.

b. JMFU team composition is operation-dependent. The example here uses a mix of personnel from different Service components. The key to a successful JMFU is to amass the proper functional expertise to complement the JTF mission, including the following personnel.

- An officer in charge.
- A mix of meteorologists and forecasters (officer and enlisted mix) for initial rapid response to requests for focused area of operations support.
- Weather apprentices and/or aerographer mate technicians.

4. METOC Related Duties

The JMFU is responsible for the following duties.

a. Refine operational requirements.

b. Obtain METOC data.

c. Analyze METOC data.

d. Handle classified material, sensitive compartmented information, and/or special access requirements when appropriately cleared.

e. Disseminate METOC information via available communications resources to include C4I systems architecture.

f. Prepare and disseminate JOAF.

g. Prepare and disseminate special support products as required.

h. Perform a meteorological watch for the joint force area of interest.

i. Amend and/or update products as required.

j. Perform quality control.

k. Perform effectiveness evaluation.

l. Provide support to JFC components.

m. Provide support to SMO, JMO, and/or JFC staff as required.

n. Prepare report inputs as required.

o. Serve as net control station (NCS) for METOC HF operations, if required.

p. If required, perform system manager functions on tactical weather systems and operator maintenance on equipment.

q. Develop logistic requirements for JMFU operations.

r. Implement, manage, and monitor the theater METOC server.

APPENDIX J
COMMUNICATIONS

1. Overview

This appendix provides the SMO and JMO with an overview of the communication concepts and capabilities of the Services to support the METOC operations identified in Chapter IV, "Joint Force METOC Operations." To the maximum extent possible, conduct METOC operations using common C4I systems.

2. Requirements

The rapidly changing nature of the air, space, and ocean environments makes METOC data extremely perishable. Therefore, effective METOC support to joint operations is dependent upon timely, reliable communications that allow for the rapid transfer and refresh rate of METOC data to all deployed forces. In simplest terms, all METOC units must be able to share METOC information with each other to ensure consistency and accuracy of information at all stages of the operation. It is vital that all forces involved be able to communicate with each other in both clear and secure modes. Communication of METOC information should be designed to fulfill the data collection, storage, retrieval, and dissemination efforts of the METOC forces at all levels. In a broad sense, the concept includes the following.

a. The flow of information between all component-level METOC forces within the AOR.

b. The flow of information between all METOC forces within the AOR. For example, the METOC unit supporting the Army component should be able to pass forecasts and observations to the Navy component and the JMFU. It should be noted that the JMFU is not the primary conduit of the METOC data flow between existing METOC centers and tactical units, but rather it integrates METOC information.

c. The flow of METOC information from tactical METOC forces back to the JMFU and out of the AOR.

3. Considerations

Specific responsibilities concerning communications are contained in CJCSI 3810.01A, "Meteorological and Oceanographic Operations." However, the following items should be considered to ensure the flow of METOC information throughout the AOR.

a. Communications links between the MFC, JMFU, JMO, SMO, components, and tactical METOC forces.

b. Required COMSEC material for use within the AOR.

c. Terminal equipment required at the JMFU (e.g., METMF, Tactical Forecast System (TFS), server, HF transceivers, Tactical Very Small Apeture Terminal, NITES).

d. Requirements for satellite broadcast and component HF support.

e. Direct access to JWICS, SIPRNET (with access to GCCS and INTELINK-S), and NIPRNET.

4. Notional Communications Architecture

a. To turn the communications requirements into a working system, each participating METOC element must

understand the generic flow of METOC information throughout an AOR. This flow is graphically depicted in Figure J-1. By understanding the generic architecture and how each of the component METOC forces passes information, the SMO, JMO, and J-6 can better tie the pieces together into a whole.

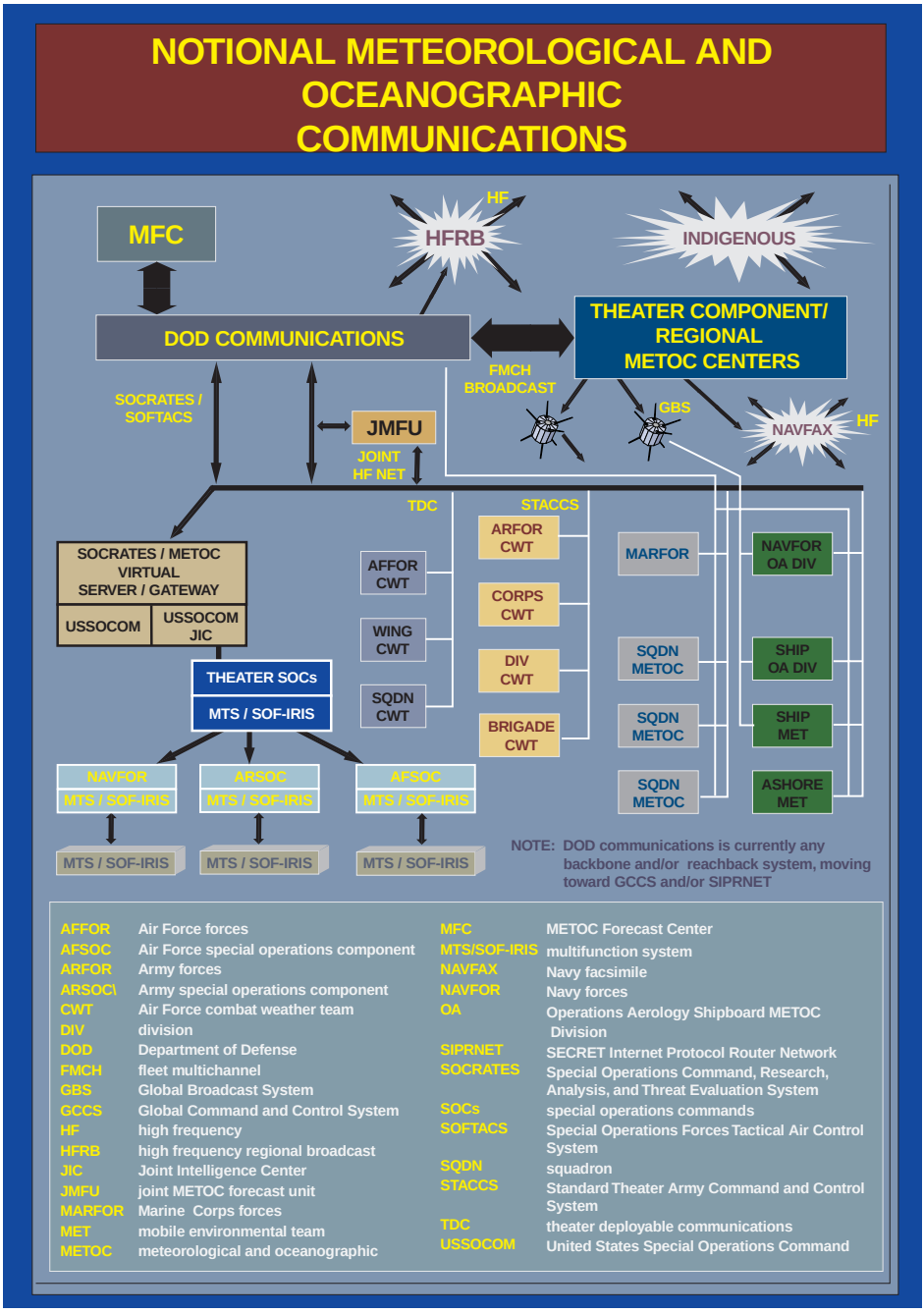


Figure J-1. Notional Meteorological and Oceanographic Communications

b. The backbone of the METOC communications structure which allows connectivity into and out of the AOR is the DISN. The DISN allows worldwide and theater data to flow into the AOR from the MFC. DISN connectivity also allows for METOC information collected in the AOR to be available for use by the MFC. DISN can be used for the flow of classified and unclassified METOC data.

c. Within the AOR, METOC information must be exchanged using Service communications links and joint C4I systems.

5. JMFU Communications and Equipment

The JMFU focuses on the integration of METOC information from joint force components, MFC, and tactical sources. As such, meticulous communications planning is critical to success. The communications required will change significantly depending on the nature and size of the joint operation. The JMFU will primarily rely on SIPRNET and/or NIPRNET, satellite broadcast, and HF broadcast (from HFRB or Navy facsimile [NAVFAX]). The JMFU communication requirements will depend on where they are located. Specific type of connectivity to the JMFU and MFC depends on what terminal equipment is available and can be supported by the theater communications capabilities.

a. If the JMFU has robust DISN connectivity and access to a TFS and/or automated weather distribution system (AWDS), TESS and/or NITES, METOC Integrated Data Display System-Tactical (MIDDS-T), IMETS, or METMF, then METOC data will primarily be received via these self-contained systems.

b. If the JMFU does not have sufficient DISN connectivity to effectively use TFS and/or AWDS, IMETS, TESS and/or NITES, MIDDS-T, or METMF, it will rely on the "early-in" techniques described later in this appendix until DISN connectivity is achieved with the MFC.

c. **METOC HF Net.** When other, more reliable means are not available, one method of communication among METOC forces is via an HF net. HF should be considered as a backup only and not planned for use as the primary means of communications. If the JMO establishes an HF net, the JMFU or one of the Service components may be the NCS. The NCS must work with the J-6 to gain frequency clearance by the host nation, coalition forces, and joint Services before operating any transmitter. The net is operated using a joint key list which is controlled by the Intertheater COMSEC Package (ICP) manager. HF-equipped units should establish requirements for COMSEC material through local COMSEC custodians. The NCS will provide field units with both AN data and facsimile products over the METOC net. Field units will attempt to transmit data to the NCS directly. If unable to contact the NCS, field units must try to contact other units on the net to ensure that data is passed. The NCS will collect all observations, forecasts, and upper-air data from field units and transmit them to other network hubs and/or stations, JMFU (if not designated the NCS), and the MFC. The JMFU will input METOC data into the AWN. The following topics are standard for NCS operations, and should be considered for inclusion in an HF section in the LOI.

- Frequencies and frequency clock (best use of available frequencies during various times of the day)
- Transmission schedule
- HF net KQ identifiers, nodes, and call signs

d. **HFRB System.** The HFRB system is a receive only system designed to provide

dedicated METOC teletype and facsimile data to deployed units. Air Force HFRBs are operational at Elkhorn, Nebraska and Homestead Air Force Base (AFB), Florida. NAVFAX broadcasts are available in Atlantic Command and Pacific Command on "Request Only" basis from the appropriate regional centers listed in Appendix M, "METOC Forecast Center."

e. **JMFU Afloat.** Ships most capable of providing the manpower, equipment and communications infrastructure to support an afloat JMFU include aircraft carriers, amphibious command ships, or amphibious assault ships that are equipped with TESS and/or NITES and GCCS. The SMQ-11 satellite receiver acquires and processes data from polar orbiting and geostationary satellites into TESS and/or NITES. TESS and/or NITES are integrated into shipboard C2 systems to provide access to established DOD C4I and Service networks. A JMFU has access to established common-user satellite communications networks that can be used to disseminate METOC products to component commanders through Service and/or joint networks. The ship can transmit and receive classified Automatic Digital Network (AUTODIN) traffic, access commercial voice networks and/or the Defense Switched Network (DSN), and can operate in a secure environment using secure telephone unit-III (STU-III).

6. Service-Unique Systems

Within each component, capabilities, procedures, and equipment vary. The following is a description of each Service's METOC communications structure so that the SMO and JMO can better integrate all resources within the AOR.

a. **Navy.** Naval METOC Production Centers (NAVOCEANO and FLENUMMETOCCEN) are the hubs for the dissemination of global and regional METOC data and/or models to regional METOC centers as well as to METOC forces worldwide. The regional centers are aligned with the CINC's Navy component commanders and manage the dissemination of global and regional data as well as locally produced METOC products within their AOR. Products are made available to theater forces via the DISN (NIPRNET, SIPRNET, and JWICS). Afloat customers access METOC products via SIPRNET and TESS and/or NITES (aircraft carriers, large deck amphibious, and C2 ships only), satellite fleet multi-channel broadcast, AUTODIN, Streamlined Automated Logistics Terminal System, and on-demand HF facsimile broadcasts.

b. **Army**

- In the AOR, the Army receives products from the non-theater MFC production facilities at a single theater entry point, if one exists, or at the Army tactical support communications system collocated with the highest Army echelon deployed (or, if a direct satellite broadcast weather communications capability exist, directly to subordinate USAF CWTs through USAF provided and maintained standard ground transceivers). CWTs at either the theater, ARFOR, or Corps level have the responsibility to coordinate the transmission of data to lower echelons through standard Army communications, although the path of the data and the systems used will change depending on the size and nature of the contingency. During an MTW, the ARFOR CWT acts as the coordinator for transmission of METOC data from outside the AOR to the lower echelon CWTs. During MOOTW missions, weather support may be organized into a single, small CWT designed to support a brigade or battalion task force. A task force CWT may need an alternate source of communications until the normal theater, ARFOR, or

Corps communication structure is established in the AOR.

- In an MTW, a full contingent of CWTs and communications equipment will deploy with the ARFOR, Corps, Divisions, ACR, and Special Forces groups and/or Ranger Regiment. In such an MTW, the ARFOR CWT, equipped with QRCT III or IMETS, will tailor and retransmit MFC-prepared products to the lower echelons using the ABCS. The IMETS will be the CWT's main weather system connected to the ABCS. In addition, QRCT III HF Radio networks provide an alternate, limited mode of AN communications among CWTs and as a receiver for HFRB. QRCT III will be able to communicate with IMETS when a mix of systems are deployed. In an MTW without IMETS deployed, transmission of graphics over facsimile through MSE equipment can supplement QRCT III. Alden 9315 TRT-R can receive fax weather graphics broadcasts when within transmission range. In MOOTW and joint force support, split-base weather support from the ARFOR CWT, operating from Army intelligence facilities and using the Army Global Command and Control System (GCCS-A), will provide MFC products, forecasts, and observations to the G-2 until a CWT arrives. With the joint force in place, it will use a combination of split base support, local indigenous information, and data received by tactical equipment deployed with the CWT. With transportable computers and modems, the CWT can use dial-in access to the MFC. In a MOOTW which transitions to an MTW, the capabilities of a full ARFOR CWT with IMETS will be built as quickly as the headquarters, and headquarters companies of the Corps and Divisions arrive in the theater. The flow of METOC data would also transition from split base, GCCS-A transmission to reception of MFC products at the ARFOR IMETS and transmission to the lower echelon CWTs as described earlier for an MTW.

c. **Air Force.** Air Force METOC communications are currently centered around the AWN as the primary means of receiving and disseminating AN weather data and graphical weather data but are rapidly migrating to high speed information transmission services such as global broadcast service and common user networks such as DISN. Systems such as the web-based AFWIN, SAFWIN, and/or JAFWIN provide access to METOC information over state-of-the-art secure and unsecure communications. HFRB broadcasts and HF and/or QRCT III net operations when available, are a viable backup. Outside the Korean theater, QRCT III operations are limited to Army operations. AN data and graphics products are made available in theater primarily via data sources that rely on the DISN such as the Meteorological Information Standard Terminal and AFWIN/SAFWIN.

d. **Special Operations Forces.** Generation and dissemination of METOC data sets to SOF units requires timely access to data from a number of varied sources both inside and outside the SOF community. SOF METOC elements use a laptop computer loaded with standard application software that provides mapping, word processing, image analysis, electronic mail, spreadsheet, document storage, search, and retrieval, computer aided design, and backup capabilities. This laptop can access backbone communications, other Services' networks, and dial-in systems. It also interfaces with antennas and receivers for receipt of geostationary and unencrypted polar-orbiting meteorological satellites. This METOC ADP support is compatible with SOF deployable intelligence ADP capabilities.

e. **Marine Corps.** METMFs in the MWSS are equipped to receive the fleet multichannel broadcast. The fleet multichannel broadcast via satellite is the primary source for METOC information. The METMFs are also equipped to receive HFRB as well as indigenous HF broadcasts in the AOR. Web-based NIPRNET/SIPRNET and dial-in systems, such as NODDS and AFWIN, provide additional METOC data collection capabilities. For transmission capabilities, the METMFs rely on HF and MAGTF C4I local area network and/or wide-area network to disseminate METOC information to organic units. The MEF SWO and MSTs are equipped with the IMOSS or its replacement, a portable METOC system, Navy's NITES IV, as described in Appendix K, "Deployable METOC Equipment." The portable system will have an HF receive capability and be able to access/disseminate via conventional and/or tactical communication paths, the MEF SWO can also collect METOC information using G-2 resources, systems, and networks.

7. Early-In and Initial Communications Concept

a. Early-in communications equipment must be capable of allowing the METOC forces to support the warfighter until sustaining backbone communications are available. Early-in communications include HF broadcasts, satellite and telephone lines. AMC tanker airlift control elements (TALCEs) have an indigenous satellite communications (SATCOM) capability. AMC TALCEs forward their observations and forecasts via SATCOM to the tanker airlift control center (TACC) for injection into the AWN. The TACC can also forward limited AN theater weather data packages to deployed TALCEs. Air Force HFRB and Navy on-demand NAVFAX take AN and graphic weather information from dedicated circuits and transmit it to tactical HF receivers. HFRB operates in the unclassified mode. These fixed site broadcast stations are pre-existing at the following locations and can be used as an early-in capability.

- Elkhorn, Nebraska; operated by Air Combat Command.
- Barrigada, Guam; operated by the USN.
- Isabell, Puerto Rico; operated by the USN.
- On-demand NAVFAX in the Pacific: Diego Garcia; Guam; Japan; Hawaii; and Stockton, California. Alternate broadcast sites are located at Australia's Northwest Cape (Naval Communication Station Harold E. Holt) and San Diego, California. The data for these broadcasts originate from NAVPACMETOCCEN.
- On-demand NAVFAX in the Atlantic: Norfolk, Virginia; Cutler, Maine; Jacksonville, Florida; Key West, Florida; Isabella, Puerto Rico; Keflavik, Iceland; and Guantanamo Bay, Cuba. The data for these broadcasts originate from NAVLANTMETOCCEN.
- On-demand NAVFAX in the Mediterranean area: Sigonella, Sicily. The data for these products originate from NAVEURMETOCCEN.

b. METOC dial-in systems can also be used for early-in operations or as backup during NIPRNET and/or SIPRNET outages. Various Navy and Air Force METOC facilities have systems which users can access to acquire METOC information for their use in planning, analysis, and forecasting. These systems provide a capability to obtain timely access to a wide range of METOC products from practically anywhere in the world. The JMO and component METOC officers should consider the requirements for and viability of using these systems to augment the METOC support effort at the JMFU and component levels, particularly before backbone

communications are established. Users access these systems using a phone dial-in from a computer over established telephone lines or via SATCOM access (e.g., International Maritime Satellite B [INMARSAT-B]) to satellite based telephone communications circuits. These communications paths limit the use of these dial-in systems since the availability of telephones or SATCOM may be highly dependent upon the remoteness of the battlefield or whether a unit has SATCOM equipment. Appendix L, "METOC Dial-In Bulletin Board and Web-Based Systems," provides more detail on both classified and unclassified bulletin board systems and information on their capabilities and use.

c. NIPRNET and SIPRNET systems are also key to an early-in communications concept. These connections are generally available in limited quantity during the initial days of a deployment, but can become more robust after 1 to 2 weeks in the AOR. This is an effective means to provide initial support from an established METOC facility to a limited METOC force operating in an austere communications environment.

8. Security Considerations

The JFC is responsible for denial of METOC information to an enemy. When required, encryption of METOC data should be accomplished with the appropriate subset of keying material provided by the local COMSEC custodian. Since the JMFU and MFC require these observations for their computer models, the encryption of observations must be standardized to protect location. The joint keying material provides that standardization. HF equipment should operate with KG-84 model encryption gear so that all HF equipment in use can use compatible COMSEC tapes. The JMFU or Service component will operate the theater HF net using joint keying material provided by the ICP manager at MacDill AFB, Florida. Joint keying material may be used to encrypt information (e.g., an observation's location) before passing it over nonsecure lines. Likewise, theater HFRB broadcasts will use joint keys when encrypting. Common use of the joint keying material will provide a standardized interoperable method of encoding originating locations for METOC products.

9. KQ Identifiers

Units deployed for an operation will require a tactical station identifier (KQ identifier). AFWA is the central manager for KQ identifiers for Air Force and Army. The supported CINC's SMO has the option for assigning KQ identifiers for all weather teams in the theater of operations. In the absence of published guidance by the theater SMO, deploying weather teams will obtain their KQ identifiers from AFWA. Navy and Marine Corps KQ identifiers are obtained from FLENUMMETOCCEN Detachment Tinker. Normally, units should obtain these on their own prior to deployment, but can also obtain them after arrival in theater. The JMO must ensure that there is only one active KQ identifier reporting for each location (although there may be more than one unit at a particular location with KQ identifiers).

Intentionally Blank

APPENDIX K
DEPLOYABLE METOC EQUIPMENT

1. Overview

This appendix provides an overview of the METOC tactical equipment that may be available to components within a joint force. **Note:** This list is not intended to suggest that all individual Service METOC units supporting their local operation would have and maintain this equipment. For a detailed list and complete description of these and other mobile systems available, refer to the Federal Directory of Mobile Meteorological Equipment and Capabilities published by the Office of the Federal Coordinator for Meteorological Services and Supporting Research.

2. Air Force

a. **AN/TMQ-34, Tactical Meteorological Observing Set.** Provides measurement of temperature and dew point, wind speed and direction, precipitation, and barometric pressure in a tactical environment.

b. **Manual Observing System.** Contains instruments to allow an observer to make observations of temperature, dew point, wind speed and direction, precipitation, ceiling, visibility, and atmospheric pressure.

c. **AN/GMQ-33, Cloud Height Set.** Self-contained, operator maintained, portable unit that determines and displays the base height of cloud layers directly overhead by the use of a laser.

d. **AN/TMQ-36, Tactical Wind Measurement System.** Operator-maintained, self-contained, portable unit that provides measurement of wind speed and direction.

e. **AN/GRQ-27, HF Flyaway Communications System/QRCT III.** Standard secure tactical communications using Joint Interoperability of Tactical C2 System message text formats. All versions include an Alden 9315 TRT HF receiver and recorder.

f. **Wraase Weather Satellite Receiver System.** The Wraase system is a commercial, off-the-shelf, portable satellite receiver that receives imagery from geostationary and civil polar orbiting satellites. The Wraase system cannot receive DMSP imagery.

g. **Alden Weather Facsimile (WEFAX) 3T Receiving Set.** This is a commercial, off-the-shelf system for receiving WEFAX pictures from geostationary operational environmental satellite, METSAT, and Geostationary Meteorological Satellite.

Wind direction and speed may be measured by using the AN/TMQ-34, -36, or manual observing systems.

The Wraase system cannot receive DMSP imagery.

h. **Alden Compact Facsimile (9315TRT).** Commercial, off-the-shelf facsimile receiver and recorder with a built-in HF synthesized receiver. It includes radioteleprinter reception capability at 67 and 100 words per minute.

i. **ML-102G, Barometer.** Portable, highly accurate aneroid barometer which is designed for use in fixed or tactical locations.

j. **AN/TPS-68, Tactical Weather Radar.** C-band weather radar system housed inside S-280 shelter housing (8ft x 8ft x 12ft).

k. **Weather Facsimile and Teletype HF Recording System.** Receiver and recorder that copies radio facsimile weather charts and radio teleprinter text broadcasts.

l. **AN/UMQ-12, MARWIN Tactical Upper-Air Wind Measuring Set.** Automatic tracking, operator-maintained, portable unit that provides upper-air wind direction and speed, pressure, temperature, and relative humidity to an altitude of 30 kilometers.

m. **AN/TMQ-43, Small Tactical Terminal (STT), Meteorological Satellite Receiving System.** The STT is a modular satellite reception terminal which provides receive only capability for both low and high resolution weather satellites. It comes in five STT versions: basic, enhanced, joint task force satellite terminal, L-STT, and workstation.

n. **Tactical Forecast System.** TFS is a small, lightweight, modular system designed for production of weather forecasting products. It is the standard system for deployed, garrison, and weather center operations. TFS software will consolidate the following functions onto Combat Air Forces workstation; AWDS capability to analyze data and prepare forecast products, EO-TDAs, Air Force Combat Climatology Center (AFCCC) applications, display Air Force Weather Agency Dial-In Subsystem (AFDIS), NODDS, and AFWIN and/or SAFWIN data. TFS will also interface with STT and interface with STT and multiple external systems via C4I networks (e.g., NIPRNET, SIPRNET).

o. **International Marine Satellite Terminal.** Since the use of INMARSAT is governed by international agreements, this system may not necessarily be available for all non-routine operations. There are a limited number of INMARSAT terminals fielded to Army and Air Force weather units. INMARSAT terminals will be used for

deployed telephone communications, to include voice and data.

p. **Electronic Staff Weather Officer Kit (ESK).** ESK is a personal computer, in either a laptop or desktop configuration, with office automation, Air Force and Navy METOC dial-in, and network software. ESK's primary role is to provide deployed weather teams with access to basic weather products (e.g., AFWIN and SAFWIN products, satellite imagery, forecast charts) when TFS is not available, and to supplement TFS operations.

3. Army

In addition to the above Air Force support equipment, Army weather support units use the following systems.

a. **AN/TMQ-40, IMETS.** IMETS receives, processes and distributes METOC data and/or information over Army tactical command and control systems. It has communications compatibility with All Source Analysis System, Digital Terrain Support System, and HF QRCT III systems, and receives weather satellite information. It is highly mobile multi-wheeled vehicles mounted, with a standard integrated command post shelter, and is C-130, rail, and sea transportable.

b. **AN/TMO-41, Meteorological Measuring System.** Automatic tracking, deployable system that provides upper-air wind direction and speed, pressure, temperature, and relative humidity to an altitude of 30 kilometers.

4. Navy

a. **Tactical Environmental Support System and/or Navy Integrated Tactical Environmental System.** TESS and/or NITES are modular, interactive, computer-based systems which collect, processes, analyze, display, and disseminate METOC data and products. Sources of data include FLENUMMETOCCEN, remotely sensed satellite data and imagery, AN data from the fleet broadcast, locally-observed data, and the SIPRNET.

b. **Navy Integrated Tactical Environmental System.** Government and/or commercial, off-the-shelf modular, interactive METOC analysis and forecasting system for the simultaneous reception, processing, display, and dissemination of METOC data which will become operational in FY99. NITES will be compliant with the defense information infrastructure (DII) common operating environment (COE) where applicable. Modular, DII COE-compliant segments will support Navy and Marine Corps configurations for regional METOC centers, ships, GCCS-M workstations in non-METOC spaces, METOC facilities and detachments with or without a tactical support center, MET, Marine Corps Air Stations, MSTs, and the Allied Environmental Support System. Primary network connectivity will be provided by the Joint Maritime Communications Systems, NIPRNET, and SIPRNET. The fielded NITES versions are as follows.

- **NITES I.** Local data fusion center and principal METOC analysis and forecasting system, consisting of both classified and unclassified workstations.
- **NITES II.** Classified METOC software segment for the GCCS-M and/or GCCS.
- **NITES III.** Unclassified forecast, briefing, and display system tailored to METOC shore activities supporting aviation operations.
- **NITES IV.** Portable system tailored to mobile METOC support to C4I surveillance and reconnaissance.

c. **METOC Integrated Data Display System-Tactical.** Government and/or commercial, off-the-shelf client-server based METOC analysis and forecasting system for the simultaneous reception, processing, display and dissemination of METOC data. MIDDS-T currently receives satellite imagery, digital facsimile charts, analog facsimile, AN, NODDS and/or Optimum Path Aircraft Routing System (OPARS), AFDIS, satellite message, Graphics Fleet Mission Program Library, and radar data. MIDDS-T provides briefing support for Navy and/or Marine Corps aviation. Each MIDDS-T is a stand-alone system where each may be set up differently to meet current operational requirements. MIDDS-T capabilities are being incorporated into NITES.

d. **Alden Marinefax TR-IV Recorder.** Commercial, off-the-shelf facsimile designed to receive and reproduce radio facsimile weather charts from HF radio transmissions.

e. **Interim Mobile Oceanography Support System.** IMOSS is a three-part hardware and software package that provides computational, communications, and satellite modules. The computational module is a personal computer (PC) based system which uses the Geophysics Fleet Mission Program Library to generate meteorological, electromagnetic, oceanographic, and acoustic forecasts. The communication module will receive AN data via the HF receiver or the ship's SATCOM network. The communication module is connected to a HF receiver. The satellite module will receive, store, and provide the computational module with automatic picture transmission data from NOAA and/or TIROS-N and Russian meteorological polar-orbiting satellites.

f. **AN/UMQ-12, Mini Rawin System.** Upper-air data collection system consisting of receiver and balloon launched rawinsondes. Data collected includes pressure, temperature, relative humidity, and wind as a function of height above the surface of the earth. Networked to the TESS/NC.

g. **AN/SMQ-11, Meteorological Data Receiver-Recorder Set.** The SMQ-11 system is capable of receiving, storing, and manipulating high resolution polar orbiting satellite data and geostationary satellite imagery.

h. **Naval Satellite Display Station-Enhanced (NSDS-E).** NSDS-E is a satellite receiving system. It receives both geostationary and polar orbiting imagery from METOC satellites, stores the received data, and provides the means to manipulate, analyze, and enhance imagery, as well as further distribute the data to other METOC systems such as NITES. NSDS-E is capable of outputting both raw data and processed, enhanced imagery.

i. **Marta Geostationary Weather Satellite Direct-Readout Ground Station.** Low cost commercial, off-the-shelf receiver that acquires, processes, and displays high-resolution digital imagery directly from geostationary satellites. Graphics display application is incorporated into the MIDDS-T system. Data fusion supports the ability to overlay any infrared (IR), water vapor, or visible image combination.

5. Marine Corps, METMF

Each MWSS is equipped with a METMF complex normally deployed to a forward operating base in direct support of that airfield. A METMF complex consists of the following.

a. **AN/TMQ-45, Primary METMF.** The AN/TMQ-45 is configured with extensive communications equipment, including SIPRNET access capability, to allow reception and transmission of encrypted and unencrypted METOC data in AN, facsimile, and voice formats.

b. **AN/TMQ-46, Secondary METMF.** The AN/TMQ-46 is configured to provide a clean area for maintenance of sensitive electronic equipment.

c. **AN/TMQ-47, Weather Radar (AN/FPS-106).** The AN/TMQ-47 is configured with an AN/FPS-106 weather radar which has the capability to detect, analyze, and track meteorological phenomena within a 200 nautical mile radius and to an altitude of 60,000 feet. Note: Only fixed-wing MWSSs possess the AN/TMQ-47.

d. **AN/TMQ-35, (MARK-IV).** The AN/TMQ-35 provides for the capture, manipulation, and detailed analysis of imagery originating from DMSP and NOAA polar-orbiting satellites.

e. **METMF Replacement (METMF [R]).** The METMF (R) is a fully integrated system capable of automatic data acquisition from communications channels providing METOC data, meteorological satellite downlinks, and local and remote meteorological sensors. The METMF (R) will be capable of disseminating METOC data and products via communication links, such as the MAGTF C4I local area network and SIPRNET, and an indigenous video briefing system. The METMF (R) consists of ten subsystems.

- **Processing Subsystem (PCS).** The PCS consists of NITES I and II as described in para 4b of this Appendix.

- **Communications Subsystem (CSS).** The CSS is capable of transmitting and receiving secure and non-secure data from meteorological channels of the fleet multi-channel broadcast, USAF HFRB, worldwide meteorological broadcast frequencies, satellite communications, and secure/non-secure internet protocol router.

- **Meteorological Satellite Subsystem (MSS).** The MSS receives high and low resolution meteorological imagery from polar/geostationary orbiting satellites.

- **Rawinsonde Subsystem (RWS).** The RWS consists of the AN/UMQ-12, Mini Rawin System, described in para 4f of this Appendix.

- **Local Sensor Subsystem (LSS).** The LSS measures and reports meteorological observations, including surface wind direction and speed, surface air and dew point temperature, liquid precipitation, cloud height, visibility, atmospheric pressure, and lightning detection.

- **Remote Sensors Subsystem (RSS).** The RSS consists of two remote sensor sets capable of reporting meteorological information up to 200 nautical miles from the METMF (R). The RSS measures and reports surface wind direction and speed, surface air and dew point temperature, liquid precipitation amounts, and atmospheric pressure.

- **Video Subsystem (VDS).** The VDS is capable of originating and displaying video images to on location external of the METMF (R).

- **Meteorological Radar Subsystem (MRS).** The MRS is a Doppler system capable of providing real-time, surveillance, and advanced warning of potentially hazardous atmospheric conditions in the vicinity of the METMF (R).

- **Portable Meteorological Sybsystem (PMS).** The PMS is the Navy's IMOSS until replaced by NITES IV, previously described in para 4b of this appendix. There are two PMSs per METMF (R)

— one is for use by the MSTs and one for use by the MWSS.

- **Shelter Subsystem (SSS).** The SSS consists of one standard International Organization for Standards (8'x8'x20') shelter, environmental control units, and power distribution systems.

6. Special Operations Forces

In addition to service standard systems, SOF METOC elements may be equipped with unique equipment, such as SOF METOC systems.

APPENDIX L
METOC DIAL-IN BULLETIN BOARD AND WEB-BASED SYSTEMS

1. Overview

This appendix provides an overview of the various "dial-in" and "web-based" systems that the Air Force and Navy have available for a joint force to obtain METOC data.

2. Dial-In System Descriptions

a. **Naval Oceanographic Data Distribution System.** An unclassified system allowing access to FLENUMMETOCCEN environmental products. The user defines the products desired for an area and initiates an automatic process of acquiring the data, using a commercial communications protocol. The program extracts data for each field and/or product from a global or regional data base depending upon the area selected and transmits in a compacted, communications-efficient format. Once the raw data is received by the user's NODDS system, the software contours, streamlines, and shades automatically until all products are in a ready-to-display format. The system downloads data via modem to a PC or laptop computer. Products include contoured, gridded data fields of meteorological and oceanographic parameters (e.g., surface weather analysis and progs, standard levels upper-air height, temperature, and/or thickness, analysis and progs, sea surface temperature), 3-D gridded data fields (GDFs), upper-air soundings, surface reports, DMSP satellite imagery, general acoustic conditions charts, and high wind and seas warnings. Product runs refresh at 12-hour intervals. Users connect to NODDS via DISN, DSN, Public Switched Telephone Network (PSTN), STU-III, INMARSAT, or commercial telephone (including cellular). There is cost incurred by the use of commercial telephone systems to acquire products.

b. **55th SWXS Dial-In System.** Allows customers to access space environmental bulletins. Types of products include HF propagation and atmospheric and interference conditions. For system access dial DSN 560-6257. System is menu driven (when accessing for the first time, users will need to request an account, password, and user identification).

c. **Autopolling and/or Voice Facsimile.** Distributes unclassified METOC information via a dial-in facsimile system. The system is entirely automated, with the user selecting METOC graphics from a variety of product groups and initiating the transmit process. The system will fax the selected products to the user's telefax machine or PC. Users can access this system using any nonsecure telefax machine or PC-based telefax system. Products include surface and upper-air analysis and progs, high winds and/or high seas graphics, sea height analysis, and ocean frontal charts as well as analysis and forecasts of sea ice. Users can select prepackaged groups of products from a menu-driven listing. Products are available on-call 24 hours a day at the cost of dialing into the system.

d. **Personal Computer Image Communications System.** Software package that downloads satellite images reflecting primarily oceanic sea surface temperature features by telephone-modem for display on a computer. Satellite images are binary files and software is used to enhance the sea surface temperature images. Software is similar to NODDS and can be collocated with NODDS.

3. Web-Based System Description

a. **Air Force Weather Information Network, Secure Air Force Weather Information Network, and JWICS Air Force Weather Information Network.** AFWIN provides the NIPRNET-connected user with the capability to select, retrieve, and display AFWA products using commercial, off-the-shelf web browser software. SAFWIN provides the SIPRNET-connected user with the capability to select, retrieve, and display AFWA products web browser software. SAFWIN was designed to mirror AFWA's AFWIN product suite and provide additional classified products via the SIPRNET. SAFWIN will mirror the AFWIN growth to the classified user and continue to exploit technology to enhance classified support. JAFWIN is similar to SAFWIN but supports the Intelligence Community.

b. **AFCCC Homepages and File Transfer Protocol (FTP) Sites.** This Internet style homepage allows the user to submit requests for climatology support, to view selected climatology products, and to download selected software. The NIPRNET homepage is accessible via the Internet. The SIPRNET homepage basically mirrors the NIPRNET homepage. AFCCC also maintains an unclassified FTP site for those who do not have NIPRNET and/or SIPRNET access but do have a modem and telephone access. The product suite contains items such as 30, 60, and/or 90 day visualizations, operational climatic data summaries, airfield flying weather statistics, and PC software such as SKEW-T PRO and NITELIGHT. It also contains hot links to other NIPRNET and/or SIPRNET sites.

c. **Naval METOC Operational Support Web (NMOSW).** All Naval METOC production centers, regional centers, and facilities have NIPRNET and SIPRNET homepages. All aviation detachments have NIPRNET homepages. Additionally, the production centers and regional centers have JWICS homepages. The NMOSW links all of the Naval METOC homepages of a given classification level and provides a common virtual Naval METOC data base with global real-time access to all supported Naval METOC products. Through the NMOSW, warfighter and selected customer support (data, imagery, products, chat, video) is customized as required.

d. **Joint METOC Viewer.** JMV is a government-owned system developed by FLENUMMETOCCEN and Space Warfighting Systems Command, used to view gridded METOC data. It has the capability of receiving data via the NIPRNET or SIPRNET from multiple sources and in multiple data formats. Using state-of-the-art graphical user interface, the METOC user has the ability to "rubber-band" geographic area(s) of interest and overlay a variety of data types (gridded data, satellite imagery, and observational weather symbols) and other enhancements. Products that are generated by JMV are exportable to a variety of formats, usable on stand-alone workstations, web pages, and C4I systems.

e. **55th SWXS Homepages.** Space environment data, analysis, and forecast products are available via an Internet-style homepage being developed for the NIPRNET and SIPRNET. As this transition progresses, the 55th SWXS is developing easy to understand, highly user friendly products to replace current text-based products.

APPENDIX M
METOC FORECAST CENTER

1. Overview

The DOD MFCs are composed of production facilities from two categories. The first category consists of Air Force and Navy worldwide production and climatology facilities (FLENUMMETOCCEN, AFWA, NAVOCEANO, 55th SWXS, AFCCC, and Fleet Numerical Meteorological and Oceanographic Detachment (FLENUMMETOCDET), Asheville, North Carolina). The second category consists of Air Force and Navy theater component and/or regional METOC production facilities that are responsible for a specific geographic area. All MFC production facilities can provide products that are used to support the JFC and component forces. MFC production facilities and their capabilities are described in this appendix as a tool to assist the JMO in developing and executing JFC METOC operations.

2. MFC Worldwide Production and Climatology Facilities

a. **FLENUMMETOCCEN.** The primary mission of FLENUMMETOCCEN is to provide global numerical METOC data fields to other production centers, regional centers, and operating forces worldwide. Consistency among all military forecast products is provided through the common DOD baseline global numerical METOC data set generated by FLENUMMETOCCEN. FLENUMMETOCCEN runs global and higher resolution regional atmospheric and oceanographic analyses and forecast models. Its primary global atmospheric model is the Navy Operational Global Atmospheric Prediction System (NOGAPS). NOGAPS provides the common baseline global numerical METOC data set utilized throughout the Department of Defense. The high-resolution Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) regional numerical forecast model can be relocated to cover any contingency region in the world on short notice. COAMPS is a next generation tactical scale model, providing fully integrated METOC prediction capability for DOD missions in sea-air-land operations. It can output numerical fields at resolutions less than 10 km. In addition to global NOGAPS and regional COAMPS, the Ensemble Forecast System provides a probability approach to longer-term weather prediction. The Oceanographic Wave Model is run at both global and regional resolutions. FLENUMMETOCCEN's primary ocean nowcast model is the Optimum Thermal Interpolation System, with the Thermodynamic Ocean Prediction System providing the forecast of the upper ocean thermal structure. Through linkages with DOD and NOAA environmental data distribution and satellite systems, FLENUMMETOCCEN acquires global observational METOC data. Data assimilation capabilities for initialization of the numerical models include use of all-source observational data. Data acquisition is primarily through direct connectivity to the Automated Digital Weather Switch, National Centers for Environmental Prediction, AFWA, and NAVOCEANO. Data sources include: worldwide land and ship observations, METARS, rawindsonde observation reports, drifting buoy data, bathy reports and ingest of polar orbiting satellites, and geostationary satellites by either direct readout or satellite and/or landline connectivity with receiving and/or processing sites. General product types include analysis and numerical forecast fields of primary METOC parameters. These fields are made available for distribution on Navy or joint C4I systems via Navy theater MFC production

facilities, and are sent to AFWA for use in developing products and GDFs shipped on Air Force or Army C4I systems. Available worldwide and/or regional satellite products include operational linescan system imagery (visual and/or IR), special sensor microwave imager (wind speed, rain rate, and water vapor) and scatterometery data (available via FLENUMMETOCCEN web homepages). Numerical model and satellite product dissemination is also made via NODDS (phone line and/or computer modem) and the JMV (NIPRNET, SIPRNET, and/or JWICS [INTELINK]). JMV, a web-based browser, is FLENUMMETOCCEN's primary viewer for both numerical fields and satellite products. Computer flight planning is achieved via phone line and/or computer modem using FLENUMMETOCCEN's OPARS. FLENUMMETOCCEN's numerical model output is also used to produce tailored products in response to customer requests. These products include general environmental data, ballistic winds, ocean temperature profiles and search and rescue information.

b. **AFWA.** AFWA is the DOD center for defense meteorological satellite data processing, and the only US agency providing automated worldwide cloud depictions and forecasts. Within AFWA, the Special Operations Forces Weather Operations Center provides worldwide, mission-tailored METOC services to SOF, acts as a clearinghouse for unique data requests from the SOF customers, and serves as a liaison to Navy METOC organizations providing SOF support during joint operations. AFWA focuses primarily on weather support to worldwide air and/or land operations, but can perform theater and/or regional specific support as well. To do this, AFWA integrates atmospheric and satellite observations to build an accurate, worldwide weather data base in order to produce gridded analysis and forecast fields of parameters that feed specific application programs for the warfighter. Weather reports from meteorological sources throughout the world are gathered and relayed to AFWA. These reports are combined with information available from military and civilian meteorological satellites to construct a near real time, integrated environmental data base. Computer programs then model this atmospheric data base and project changes. These models form building blocks for worldwide, tailored weather support to warfighters. Contingencies are supported using fine-scale, highly accurate mesoscale model output. Deployed forces can be supported with the Mesoscale Model 5 (MM5) on short notice, usually less than 1 hour. AFWA provides the warfighter with worldwide forecasts of hazards to flight such as turbulence, icing, and thunderstorms. Model output is used to produce worldwide forecasts of fronts, sensible weather, and instrument meteorological conditions and/or visual meteorological conditions regions. Access to numerical weather prediction (NWP) METOC fields is gained through landline connectivity with FLENUMMETOCCEN. AFWA's data acquisition is chiefly through the AWN, with observations, forecasts, and advisories relayed via high-speed circuitry. Satellite data from DMSP and the National Environmental Satellite Data and Information Service polar orbiting and geostationary satellites is relayed to AFWA via communications satellite and/or direct readout. Foreign geostationary satellite imagery is relayed over landlines. Worldwide data and product dissemination is via the Air Force Digital Graphics System for facsimile graphics; via the AWN for AN data; and the AWDS for both graphics and AN. Deployed forecasters can use AFWIN and/or SAFWIN to access AFWA generated AN bulletins, GDFs, graphical analysis and forecast products, imagery from satellite global data base and high resolution DMSP satellite imagery. Observations, terminal aerodrome forecasts, and non-AFWA AN can also be obtained. Computer flight plans, mission-tailored products, and other AN products are provided over AUTODIN to

users in the field. Computer flight plans are also delivered via PSTN, DISN, Air Force Digital Communications Network, and STU-III. General product types include cloud depiction and forecast products and air-land battle support products (E-O TDAs, soil moisture). An integrated product in the GDF format provides the basis for AFWA support to JFC operations. This support product achieves consistency through the use of common NWP data fields from FLENUMMETOCCEN. Procedures to receive support are contained in Air Force Instruction (AFI) 15-118. Additionally, graphic products and some AN products are listed in Air Force Catalog 15-152, Volumes 1, 2, and 3.

Note: FLENUMMETOCCEN and AFWA are the two primary production facilities of the worldwide MFC network. In combination, these centers provide most of the central site data and/or products needed to support in-theater requirements. Operationally, these centers are electronically connected and produce an integrated product set for the theater and are available for transmission to supported components through existing component C4I systems. Primary contributions made to the integrated product set from each site include NWP analysis and forecast fields of primary meteorological parameters, ocean basin model data and/or products from FLENUMMETOCCEN, cloud depiction, and forecast products and/or air-land battle support products (E-O TDAs, soil moisture) from AFWA. Consistency within the integrated product set is achieved through use of common NWP data fields from FLENUMMETOCCEN at both sites in the generation of all applications products. Analysis, forecasts, and parameters included in the integrated product set are shown in Figure M-1.

c. **NAVOCEANO.** The primary mission of NAVOCEANO is the global collection, processing, analysis, and distribution of hydrographic and/or bathymetric geospatial feature layers, littoral oceanographic phenomena, geophysical parameters, and imagery and/or remote sensing derived products to military services and DOD activities. This distribution is in response to strategic planning (OPLANs and OPORDs), tactical, littoral, and riverine mission execution and crisis support requirements.

CONTENTS OF THE INTEGRATED PRODUCT SET	
Temperature	Dew Point Depression
Wind Speed	Wind Direction
Geopotential Height	Surface Pressure
Cloud Analysis Products	Inversion Height
Rain Rate	Precipitation Accumulation
Soil Moisture	Soil Temperature
Snow Cover	Sea State Conditions
Visibility	Upper Air Pressure
Contrails	Inversion Top Temperature
Thunderstorms	Icing
Turbulence	Cloud Forecast Products
Relative Humidity	Vertical Vorticity
Present Weather	

Figure M-1. Contents of the Integrated Product Set

NAVOCEANO is the Department of Defense's only dedicated "center of excellence" for operational oceanographic data collection, analysis, and products. NAVOCEANO controls eight multi-purpose oceanographic and hydrographic survey ships which survey forward areas of interest against geographic CINC requirements. NAVOCEANO's Warfighting Support Center posts a number of operational products on NIPRNET, SIPRNET, INTELINK, and Joint Deployable Intelligence Support System. These products use all-source information, to include notice to mariners, commercial sources, foreign data (through exchange agreements for port, harbor, and riverine products), and other agency remotely sensed collections, to provide over 100 different essential elements of information for any given area of interest. Through agreements with naval laboratories, universities, and industry, NAVOCEANO uses aircraft, unmanned underwater vehicles, autonomous airborne vehicles, buoys, and other deployed sensors to collect tactically significant spectral data required for littoral mission support products. NAVOCEANO maintains the world's largest oceanographic, bathymetric, and hydrographic data bases, which can be accessed through classified and unclassified web interfaces. NAVOCEANO also operates the Maury Library (world's largest oceanographic library). The command also provides operational model predictions for mine drift, oil dispersion, water temperature, tides, currents, wave heights, and other oceanographic dynamic processes by using the unique computing resources of their DOD major shared resource center, which contains state-of-the-art vector and parallel processing large scale computer systems linked to the Trent Lott Visualization Institute for data simulation and display. NAVOCEANO's 1,000 employee team of military and civilian experts is comprised of engineers, computer scientists, oceanographers, mathematicians, physicists, geologists, geophysicists, biologists, image analysts, and physical scientists that make up the core oceanographic collection, analysis, and production capability. NAVOCEANO is also responsible for training all military and civilians in operational oceanography and hydrography. Foreign and US officers can attend a 6-month hydrographic program that culminates in an internationally recognized B class license. Service METOC officers can attend a joint METOC tactical training program or can select from several tactical oceanography workshops designed to emphasize marine environmental impacts on weapons, sensors, and missions in support of ASW, mine warfare, undersea warfare, special warfare, and amphibious operations. NAVOCEANO's training department also conducts training for fleet units in oceanography and hydrology, including the following courses: Tactical Oceanography Refresher, Tactical Atmospheric Refresher, Tactical Oceanography Workshop, Joint METOC Tactical Applications Course, Tactical OA Division Trainer, International Hydrographic Management and Engineering Program, Basic Oceanography Accession Training, Reserve Aerographer's Mate School, Satellite Video Tele-Training, and training and support during fleet exercises.

d. **Naval Ice Center (NAVICECEN).** The primary mission of the NAVICECEN is to provide global, regional, specialized, and tactical tailored ice products (analyses and forecasts) and services to deployed forces and other production centers. Additionally, NAVICECEN deploys ice reconnaissance teams to observe and forecast ice conditions and provide tactical METOC services throughout the polar regions.

e. **55th Space Weather Squadron (formerly Air Force Space Forecast Center).** 55th SWXS is the sole source of operational space environment support to the Department of Defense. Customers include mission planners and operators of satellites, surveillance and/or space-tracking radars, and communication systems that operate in or

through the space environment (altitudes of roughly 50 km and above). 55th SWXS is the most advanced and complete space environment support facility in the world. Advanced computer hardware and software is used to process incoming space environment measurements from ground- and space-based sensors to build a comprehensive, accurate real-time data base from which to generate analysis and forecast products tailored to specific user needs. A sophisticated on-site, real-time communications network gives 55th SWXS the ability to receive an assortment of space environment data and disseminate numerous support products to a wide variety of DOD users. 55th SWXS's mission is to provide timely and accurate space environment observations, analyses, forecasts, and warnings to enhance the operational capability of worldwide DOD forces and national agencies. To accomplish this mission, 55th SWXS observes and predicts space environment parameters for the earth's ionosphere and magnetosphere, as well as the sun and interplanetary space. 55th SWXS also provides event warning notifications for solar flares, solar radio bursts, geomagnetic disturbances, energetic charged particle events, and radio absorption events. Data collected by ground-based solar observatories and magnetometers are used to generate solar and planetary geomagnetic indices needed to specify neutral atmospheric density variations, as well as provide an overall indication of solar and geomagnetic activity. 55th SWXS also performs customer-tailored anomaly assessments of space environment impacts for spacecraft, radars, and communication systems. Communications connectivity includes telephone (DSN, Comm, and secure voice), electronic bulletin board, AUTODIN, AWN, AFDIS, AFWIN, SAFWIN, and facsimile. SIPRNET and NIPRNET homepages are being developed for SMOs and JMO personnel.

Procedures to receive support are referenced in AFI 15-118. Detailed product listing is in AFCAT 15-152, Vol 5.

f. **Air Force Combat Climatology Center.** AFCCC collects and stores global weather observations in its climatic data base. It analyzes and applies information from that data base, the Air Force Weather (AFW) Technical Library, and other sources to prepare tailored weather studies and analyses for DOD forces. AFCCC can prepare tailored weather studies on almost any facet of meteorology affecting military operations from the earth's surface through 400,000 feet mean sea level. All studies and analyses are tailored to user requests. Communications capabilities include DSN and commercial phone (both STU-III and nonsecure), Worldwide homepage, nonsecure and secure facsimile, and Defense Message System. General product types include airfield summary packages, surface observation climatic summaries, cloud ceiling climatologies (CD-ROM only), climatic briefs, specialized precipitation and temperature studies, descriptive (narrative) climatology studies, engineering design and construction studies, environmental simulation studies, low-level route climatologies, mission success indicators, wind duration studies. Selected products are currently being converted to CD ROM.

Procedures to receive support are found in AFI 15-118. Special product request procedures are provided in both Chapter II and Appendix A of AFCCC Technical Note-94/001.

Contingency support needed before JMFU activation should be requested from either an AFCCC or USAF component operations officer or the Department of Justice. USAF and/or Army support requests requiring Navy METOC climatological support input will

be coordinated between AFCCC and FLENUMMETOCDET Asheville, with response provided through AFCCC as specified by Commander, NAVMETOCCOM (COMNAVMETOCCOM) and AFW Memorandum of Agreement.

Detailed product listing is found in AFCAT 15-152, Vol 4. Additionally, a complete listing is provided in "Capabilities, Products, and Services of AFCCC," published periodically as an AFCCC Technical Note (current version is AFCCC Technical Note-95-001).

g. **FLENUMMETOCDET Asheville.** FLENUMMETOCDET Asheville manages the Navy's climatology program. In this effort, the Asheville Detachment collects, quality controls, and archives Navy and USMC meteorological observations. This data is analyzed monthly and made available via the Detachment's web site. Navy and USMC station climatology is updated at least every 3 years or more often, as required. In a joint effort with the National Climatic Data Center, an international station meteorological climatic summary (ISMCS) is produced and regularly updated. This jointly produced CD-ROM product provides over 6,500 climatology updates for stations all over the globe. Communications connectivity for the Detachment includes: secure, unsecure telephone (recording after normal work hours), Federal Telecommunications System, facsimile, and Internet access (e-mail and homepage). Additionally, the Detachment has AUTODIN message receipt and transmit capabilities. General product types include paper-based marine atlases, regional studies, and tabular publications. CD-ROM products include selected global station climatic summaries (ISMCS), global tropical atlases, global upper air data, and a global Marine Climatology Atlas. On-line products include a gridded marine data set, tropical data, Navy and USMC station data, selected manuals and instructions, and on-line request capabilities. Additionally, the Detachment serves as a repository for global gridded fields.

For procedures to receive support, see COMNAVMETOCCOM Instruction 3140.1 series, "US Navy Oceanographic and Meteorological Support System Manual," or coordinate directly via phone.

3. Theater Component and Regional MFC Production Facilities

a. **Navy.** Navy theater MFC production facilities function as regional and/or theater component hubs for dissemination of METOC data, providing a full spectrum of METOC support services to Navy component forces and joint forces upon request. These production facilities administer Navy METOC operations within assigned operating areas. Regional MFC production facilities provide tailored analyses and forecast guidance products focused on individual component's maritime and littoral operating areas. These centers routinely produce significant weather and sea advisories and warnings, individual ship route forecasts and/or aviation weather forecasts, optimum track ship routing services, deployable MET services, ocean frontal position analyses, and acoustic prediction services to support maritime operations. Additional tailored METOC data, products, and/or services can be packaged to support exercise and contingency operations. These centers can serve as the coordinating MFC during the planning and execution phase of joint operations. Expertise in regional and/or theater METOC conditions coupled with access to multiple communication paths give these centers ideal capabilities to perform the duties of a JMFU on short notice.

Theater and/or regional MFC production facilities are located as follows.

- NAVLANTMETOCCEN, NAS Norfolk, Virginia.
- NAVEURMETOCCEN, Rota, Spain.
- NAVPACMETOCCEN, Pearl Harbor, Hawaii.
- NAVPACMETOCCEN West and/or Joint Typhoon Warning Center, Guam.

Support procedures may be found in COMNAVMETOCCOM Instruction 3140.1 series, "US Navy Oceanographic and Meteorological Support System Manual," or phone the supporting theater MFC element directly to request services.

b. **Air Force.** USAF theater and/or regional MFC production facilities function as the Air Force, Army, and SOF component hubs for the dissemination of tailored METOC information support to Air Force and Army component forces within their operating areas, and joint forces upon request or tasking from the SMO or JMO. Air Force theater MFC production facilities produce and provide tailored analysis and forecast guidance products focused on the individual components' air-land areas. These centers routinely produce significant weather advisories and warnings, analyses, and forecasts as well as other tailored METOC forecast data bases, products, and/or services to support peacetime, exercise, and contingency operations. These centers produce AN and graphical products such as cloud and visibility forecasts, drop zone forecasts, hazards forecasts, air refueling forecasts, and various other tailored METOC data, products, and/or services. Detailed product descriptions and information on how to obtain specific support can be obtained by calling the individual center directly. The following is a list of Air Force theater component MFC production facilities.

- 607 Weather Squadron, Yongsan AIN, South Korea
- 11th Operational Weather Squadron, Elmendorf AFB, Alaska
- USAFE Operational Weather Squadron, Sembach AB, Germany
- 25th Operational Weather Squadron, Davis-Monthan AFB, Arizona
- 15th Operational Weather Squadron, Scott AFB, Illinois
- 28th Operational Weather Squadron, Shaw AFB, South Carolina
- 25th Operational Weather Squadron, Barksdale AFB, Louisiana
- 20th Operational Weather Squadron, Yokota AB, Japan

Intentionally Blank

APPENDIX N
REFERENCES

The development of Joint Pub 3-59 is based upon the following primary references.

1. Joint Pub 1, "Joint Warfare of the Armed Forces of the United States."

2. Joint Pub 0-2, "Unified Action Armed Forces (UNAAF)."

3. Joint Pub 1-01, "Joint Publication System, Joint Doctrine and Joint Tactics, Techniques, and Procedures Development Program."

4. Joint Pub 1-02, "DOD Dictionary of Military and Associated Terms."

5. Joint Pub 2-0, "Doctrine for Intelligence Support to Joint Operations."

6. Joint Pub 2-01, "Joint Intelligence Support to Military Operations."

7. Joint Pub 2-01.3, "Joint Tactics, Techniques, and Procedures for Joint Intelligence Preparation of the Battlespace."

8. Joint Pub 3-0, "Doctrine for Joint Operations."

9. Joint Pub 3-54, "Joint Doctrine for Operations Security."

10. Joint Pub 5-03.1, "Joint Operation Planning and Execution System Vol I: (Planning Policies and Procedures)."

11. CJCSI 3500.01A, "Joint Training Policy for the Armed Forces of the United States."

12. CJCSI 3810.01A, "Meteorological and Oceanographic Operations."

13. CJCSM 3122.02, "Crisis Action Time-Phased Force and Deployment Data Development and Deployment Execution."

14. CJCSM 3122.03, "Joint Operation Planning and Execution System Vol II: (Planning Formats and Guidance)."

15. CJCSM 3500.03, "Joint Training Manual for the Armed Forces of the United States."

16. DOD Directive Number 5100.1, "Functions of the Department of Defense and its Major Components."

17. Joint METOC Interoperability Team Functional Process Improvement AS-IS Modeling Report on Joint METOC Operations, 15 May 95.

18. AF Doctrine Document 45, 31 August 1994, “Aerospace Weather Operations.”

19. AF Doctrine Document 1, September 1997, “Air Force Basic Doctrine.”

20. Army Field Manual 6-15, 18 Jun 1992, “Tactics, Techniques, and Procedures for Field Artillery Meteorology.”

21. Army Field Manual 34-81/Air Force Joint Pamphlet 15-127, “Weather Support to Army Operations.”

22. Army Field Manual 34-130, “Intelligence Preparation of the Battlefield.”

23. Army Field Manual 100-5, “Operations.”

24. Army Regulation 115-10/Air Force Joint Instruction 15-157, “Weather Support for the US Army.”

25. COMNAVMETOCCOM Instruction 3140.1 Series, “US Navy Oceanographic and Meteorological Support System Manual.”

26. FCM-I5-1995, Dec 95, “Federal Directory of Mobile Meteorological Equipment and Capabilities.”

27. Marine Corps Warfighting Publication 3-35.7, “MAGTF METOC Support.”

28. Naval Warfare Publication-l, “Strategic Concepts of the US Navy.”

29. Special Operations METOC Tactics, Techniques and Procedures, 1 June 1996

30. TRADOC Pamphlet 525-5, 1 August 1994, “Airland Operations — A Concept for the Evolution of Airland Battle for the Strategic Army of the 1990s and Beyond.”

31. TRADOC Pamphlet 525-21/MAC Pamphlet 105-3, 10 July 1987, “Joint Operational Concept for Weather and Environmental Support to Army Operations.”

32. SOCOM Manual 525-6, March 1998, “Critical METOC Thresholds for SOF Operations.”

APPENDIX O
ADMINISTRATIVE INSTRUCTIONS

1. User Comments

Users in the field are highly encouraged to submit comments on this publication to the United States Atlantic Command Joint Warfighting Center, Attn: Doctrine Division, Fenwick Road, Bldg 96, Fort Monroe, VA 23651-5000. These comments should address content (accuracy, usefulness, consistency, and organization), writing, and appearance.

2. Authorship

The lead agent for this publication is the US Air Force. The Joint Staff doctrine sponsor for this publication is the Director for Operations (J-3).

3. Supersession

This publication supersedes Joint Pub 3-59, 22 December 1993, "Joint Doctrine for Meteorological and Oceanographic Support."

4. Change Recommendations

a. Recommendations for urgent changes to this publication should be submitted:

TO: HQ AFDC MAXWELL AFB AL//DR//
INFO: JOINT STAFF WASHINGTON DC//J7-JDD//

Routine changes should be submitted to the Director for Operational Plans and Interoperability (J-7), JDD, 7000 Joint Staff Pentagon, Washington, DC 20318-7000.

b. When a Joint Staff directorate submits a proposal to the Chairman of the Joint Chiefs of Staff that would change source document information reflected in this publication, that directorate will include a proposed change to this publication as an enclosure to its proposal. The Military Services and other organizations are requested to notify the Director, J-7, Joint Staff, when changes to source documents reflected in this publication are initiated.

c. Record of Changes:

CHANGE NUMBER	COPY NUMBER	DATE OF CHANGE	DATE ENTERED	POSTED BY	REMARKS

5. Distribution

a. Additional copies of this publication can be obtained through Service publication centers.

b. Only approved pubs and test pubs are releasable outside the combatant commands, Services, and Joint Staff. Release of any classified joint publication to foreign governments or foreign nationals must be requested through the local embassy (Defense Attaché Office) to DIA Foreign Liaison Office, PSS, Room 1A674, Pentagon, Washington, DC 20301-7400.

c. Additional copies should be obtained from the Military Service assigned administrative support responsibility by DOD Directive 5100.3, 1 November 1988, "Support of the Headquarters of Unified, Specified, and Subordinate Joint Commands."

By Military Services:

Army:	US Army AG Publication Center SL 1655 Woodson Road Attn: Joint Publications St. Louis, MO 63114-6181
Air Force:	Air Force Publications Distribution Center 2800 Eastern Boulevard Baltimore, MD 21220-2896
Navy:	CO, Naval Inventory Control Point 700 Robbins Avenue Bldg 1, Customer Service Philadelphia, PA 19111-5099
Marine Corps:	Marine Corps Logistics Base Albany, GA 31704-5000
Coast Guard:	Coast Guard Headquarters, COMDT (G-OPD) 2100 2nd Street, SW Washington, DC 20593-0001

d. Local reproduction is authorized and access to unclassified publications is unrestricted. However, access to and reproduction authorization for classified joint publications must be in accordance with DOD Regulation 5200.1-R.

GLOSSARY

PART I — ABBREVIATIONS AND ACRONYMS

ABCS	Army Battle Command System
ACR	armored cavalry regiment (Army)
ADP	automated data processing
AFB	Air Force Base
AFCCC	Air Force Combat Climatology Center
AFDIS	Air Force Weather Agency Dial In Subsystem
AFFOR	Air Force forces
AFI	Air Force Instruction
AFW	Air Force Weather
AFWA	Air Force Weather Agency
AFWIN	Air Force Weather Information Network
AMC	Air Mobility Command
AN	alphanumeric
AOR	area of responsibility
ARFOR	Army forces
ARTYMET	artillery meteorological
ASW	antisubmarine warfare
ATC	air traffic control
AUTODIN	Automatic Digital Network
AWDS	automated weather distribution system
AWN	Automated Weather Network
BT	bathythermograph
C2	command and control
C4I	command, control, communications, computers, and intelligence
CAD	collection address designator
CINC	commander in chief
CJCS	Chairman of the Joint Chiefs of Staff
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
CJCSM	Chairman of the Joint Chiefs of Staff Manual
CJTF	Commander, Joint Task Force
COA	course of action
COAMPS	Coupled Ocean Atmosphere Mesoscale Prediction System
COE	common operating environment
COMNAVMETOCCOM	Commander, Naval Meteorology and Oceanography Command
COMSEC	communications security
CONOPS	concept of operations
CONPLAN	operation plan in concept format
COP	common operating picture
CSS	communications subsystem
CWT	combat weather team

DII	defense information infrastructure
DISN	Defense Information Systems Network
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
DSN	Defense Switched Network
E-O TDA	electro-optical tactical decision aid
ESK	electronic staff weather officer kit
FALOP	forward area limited observation program
FLENUMMETOCCEN	Fleet Numerical Meteorology and Oceanography Center
FLENUMMETOCDET	Fleet Numerical Meteorological and Oceanographic Detachment
FTP	file transfer protocol
G-2	Army or Marine Corps component intelligence staff officer
GCCS	Global Command and Control System
GCCS-A	Global Command and Control System-Army
GCCS-M	Global Command and Control System-Maritime
GDF	gridded data field
HF	high frequency
HFRB	high frequency regional broadcast
ICECON	control of ice information
ICP	Intertheater Communication Security (COMSEC) Package
IMETS	Integrated Meteorological System
IMOSS	interim mobile oceanographic support system
INMARSAT	International Maritime Satellite
IR	infrared
ISMCS	international station meteorological climatic summary
J-2	Intelligence Directorate of a joint staff
J-3	Operations Directorate of a joint staff
J-6	Command, Control, Communications, and Computer Systems Directorate of a joint staff
JAFWIN	JWICS Air Force weather information network
JFACC	joint force air component commander
JFC	joint force commander
JFLCC	joint force land component commander
JFMCC	joint force maritime component commander
JFSOCC	joint force special operations component commander
JMAG	Joint METOC Advisory Group
JMFU	joint METOC forecast unit
JMO	joint METOC officer
JMV	joint METOC viewer
JOA	joint operations area
JOAF	joint operations area forecast

JOPES	Joint Operation Planning and Execution System
JSOTF	joint special operations task force
JTF	joint task force
JULLS	Joint Uniform Lessons Learned System
JWICS	Joint Worldwide Intelligence Communications System
KQ	tactical location identifiers
LOI	letter of instruction
LSS	local sensor subsystem
MAGTF	Marine air-ground task force
MAR	METOC assistance request
MARFOR	Marine Corps forces
MEF	Marine expeditionary force
MET	mobile environmental team
METARS	aviation routine weather report (translated from French; METARS is the international standard code format for hourly surface weather observations)
METCON	control of meteorological information
METMF	meteorological mobile facility
METMF (R)	meteorological mobile facility (replacement)
METOC	meteorological and oceanographic
METSAT	meteorological satellite
MFC	Meteorological and Oceanographic (METOC) Forecast Center
MIDDS-T	Meteorological and Oceanographic (METOC) Integrated Data Display System-Tactical
MOOTW	military operations other than war
MRS	meteorological radar subsystem
MSE	mobile subscriber equipment
MSS	meteorological satellite subsystem
MST	Marine expeditionary force (MEF) weather support team
MTW	major theater war
MWSG	Marine wing support group
MWSS	Marine wing support squadron
NAVEURMETOCCEN	Naval Europe Meteorology and Oceanography Center
NAVFAX	Navy facsimile
NAVFOR	Navy forces
NAVICECEN	Naval Ice Center
NAVLANTMETOCCEN	Naval Atlantic Meteorology and Oceanography Center
NAVMETOCCOM	Naval Meteorology and Oceanography Command
NAVOCEANO	Naval Oceanographic Office
NAVPACMETOCCEN	Naval Pacific Meteorology and Oceanography Center
NCA	National Command Authorities
NCS	net control station
NIPRNET	Unclassified but Sensitive Internet Protocol Router Network

NITES	Navy Integrated Tactical Environmental System
NMOSW	Naval METOC Operational Support Web
NOAA	National Oceanic and Atmospheric Administration
NODDS	Naval Oceanographic Data Distribution System
NOGAPS	Navy Operational Global Atmospheric Prediction System
NSDS-E	Navy Satellite Display System-Enhanced
N-TFS	New Tactical Forecast System
NWP	numerical weather prediction
OA	Operations Aerology shipboard METOC division
OCEANCON	control of oceanographic information
OPARS	Optimum Path Aircraft Routing System
OPLAN	operation plan
OPORD	operation order
OPSEC	operations security
PC	personal computer
PCS	processing subsystem
PIREP	pilot report
PMS	portable meteorological subsystem
PSTN	Public Switched Telephone Network
QRCT	quick reaction communications terminal
RSS	remote sensors subsystem
RWS	rawinsonde subsystem
S-2	battalion or brigade intelligence staff officer (Army, Marine Corps battalion or regiment)
SAFWIN	secure Air Force weather information network
SATCOM	satellite communications
SIPRNET	SECRET Internet Protocol Router Network
SMO	senior METOC officer
SOF	special operations forces
SOWT	special operations weather team
SPACECON	control of space information
SSC	smaller scale contingency
SSS	shelter subsystem
STT	small tactical terminal
STU-III	secure telephone unit III
SWI	special weather intelligence
SWO	staff weather officer
SWXS	Space Weather Squadron
TACC	tanker airlift control center
TALCE	tanker airlift control element
TARWI	target weather and intelligence
TESS	Tactical Environmental Support System

TFS	Tactical Forecast System
TIROS	television infrared observation satellite
TPFDD	timed-phased force and deployment data
UAV	unmanned aerial vehicle
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
USTRANSCOM	United States Transportation Command
VDS	video subsystem
WEFAX	weather facsimile

atmosphere. The air surrounding the Earth. (Joint Pub 1-02)

direct support. A mission requiring a force to support another specific force and authorizing it to answer directly to the supported force's request for assistance. Also called DS. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of Joint Pub 1-02.)

environmental services. The various combinations of scientific, technical, and advisory activities (including modification processes, i.e., the influence of manmade and natural factors) required to acquire, produce, and supply information on the past, present, and future states of space, atmospheric, oceanographic, and terrestrial surroundings for use in military planning and decision making processes, or to modify those surroundings to enhance military operations. (Joint Pub 1-02)

interoperability. 1. The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. (Joint Pub 1-02)

joint force. A general term applied to a force composed of significant elements, assigned or attached, of two or more Military Departments, operating under a single joint force commander. (Joint Pub 1-02)

joint force meteorological and oceanographic officer. Officer designated to provide direct meteorological and oceanographic support to a joint force commander. Also called JMO. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of Joint Pub 1-02.)

joint meteorological and oceanographic forecast unit. An organization consisting of a jointly supported collective of meteorological and oceanographic personnel and equipment formed to provide meteorological and oceanographic support to the joint force commander. Also called JMFU. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of Joint Pub 1-02.)

meteorological and oceanographic. A term used to convey all meteorological (weather) and oceanographic (physical oceanography) factors as provided by Service components. These factors include the whole range of atmospheric and oceanographic phenomena from the sub-bottom of the earth's oceans up to the space environment (space weather). Also called METOC. (This term and its definition are approved for inclusion in the next edition of Joint Pub 1-02.)

Meteorological and Oceanographic Forecast Center. The collective of electronically connected, shore-based meteorological and oceanographic (METOC) production facilities that includes centers such as Air Force Weather Agency, Navy Fleet Numerical METOC Center, 55th Space Weather Squadron, Naval Oceanographic Office, Warfighting Support Center, Air Force Combat Climatology Center, Fleet Numerical METOC Center Detachment, Asheville, North Carolina, and the Air Force and Navy theater and/or regional METOC production activities. Also called MFC. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of Joint Pub 1-02.)

meteorological data. Meteorological facts pertaining to the atmosphere, such as wind, temperature, air density, and other phenomena which affect military operations. (Joint Pub 1-02)

meteorological watch. Monitoring the weather for a route, area, or terminal and advising concerned organizations when hazardous conditions that could affect their operations or pose a hazard to life or property are observed or forecast to occur. Also called METWATCH. (This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication.)

meteorology. The study dealing with the phenomena of the atmosphere including the physics, chemistry, and dynamics extending to the effects of the atmosphere on the earth's surface and the oceans. (This term and its definition are approved for inclusion in the next edition of Joint Pub 1-02.)

oceanography. The study of the sea, embracing and integrating all knowledge pertaining to the sea and its physical boundaries, the chemistry and physics of seawater, and marine biology. (Joint Pub 1-02)

senior meteorological and oceanographic officer. Meteorological and oceanographic officer responsible for assisting the combatant commander and staff in developing and executing operational meteorological and oceanographic service concepts in support of a designated joint force. Also called SMO. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of Joint Pub 1-02.)

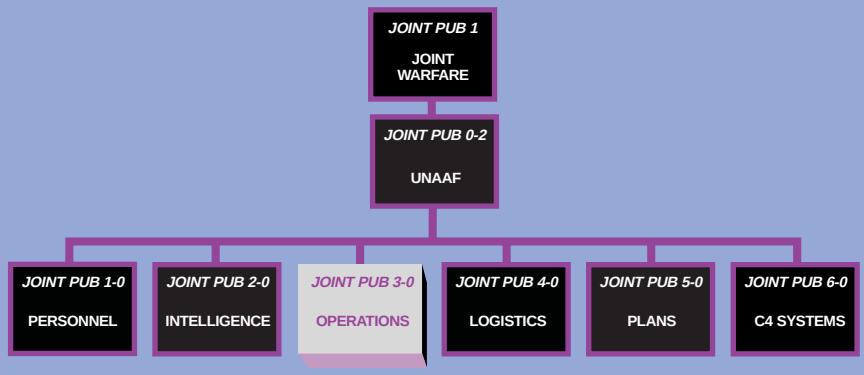
space environment. The region beginning at the lower boundary of the Earth's ionosphere (approximately 50 km) and extending outward which contains solid particles (asteroids and meteoroids), energetic charged particles (ions, protons, electrons, etc.), and electromagnetic and ionizing radiation (x-rays, extreme ultraviolet, gamma rays, etc.). (This term and its definition are approved for inclusion in the next edition of Joint Pub 1-02.)

troposphere. The lower layers of the atmosphere, in which the change of temperature with height is relatively large. It is the region where clouds form, convection is active, and mixing is continuous and more or less complete. (Joint Pub 1-02)

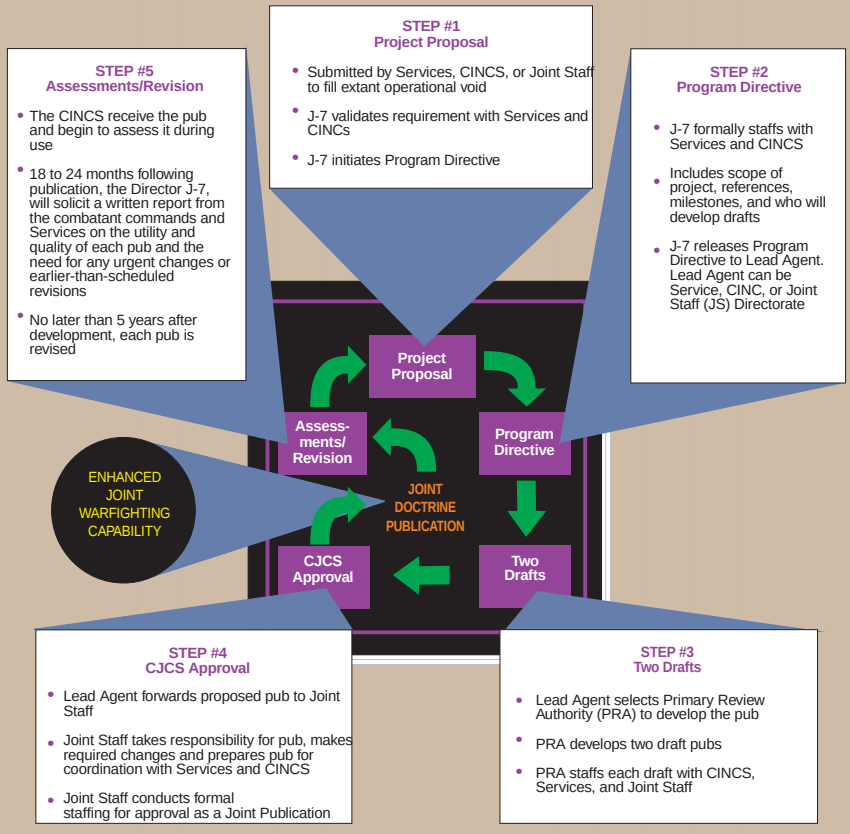
weather forecast. A prediction of weather conditions at a point, along a route, or within an area, for a specified period of time. (Joint Pub 1-02)

Intentionally Blank

JOINT DOCTRINE PUBLICATIONS HIERARCHY



All joint doctrine and tactics, techniques, and procedures are organized into a comprehensive hierarchy as shown in the chart above. **Joint Pub 3-59** is in the **Operations** series of joint doctrine publications. The diagram below illustrates an overview of the development process:




JOINT
CHIEFS OF STAFF